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FOOD MANUFACTURE

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The Editor will be glad to consider contributions from those engaged in the Food Industry. Articles intended for publication should be of a practical nature and accompanied by photographs or drawings when possible.

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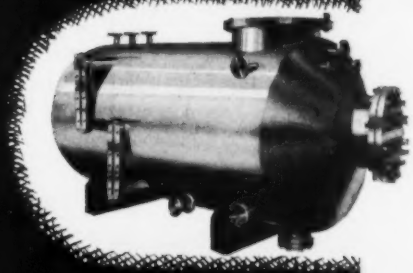

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FOOD MANUFACTURE

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Fermentation in Meat Products

FINDING that the unexpected production of voluminous amounts of CO_2 by most of the genus *Bacillus* growing in sugar-cured meats at temperatures ranging from 23·9° to 48·9° C. presented a problem of great economic importance, L. B. Jensen and W. R. Hess of Swift and Company's Research Laboratories, Chicago, have studied (*Food Research*, 6, 1, 75) the occurrence of the bacilli in nature; a specific medium to detect them; their fermentation reactions in standard sugar broths and in nitrate meat media; and the mechanism of CO_2 formation.

It was shown by Jensen, Wood and Jansen in 1934 that the bacteria causing gaseous fermentation in sugar-nitrate-nitrite cured canned meats were members of the genus *Bacillus*. These bacteria are listed in Bergey's Manual (1939) as non-gas formers from carbohydrate substrates, although bacilli of Donker's group in this genus do ferment sugars with gas production. The authors say that they have never encountered Donker's group in the packing-house.

Having established the production of gas under the conditions described above, the authors found, in addition, that a red chromogenic species often discolours the dried *charqui*, or jerked beef, of South America. They also call attention to the presence of spice contamination and food wrapping-paper contamination with the spores of the genus. In standard sugar broths no gaseous fermentation takes place, but in nitrate-sugar pork media these bacilli form much CO_2. Vitamin B_1, or thiamine chloride, induces gas production with a few strains in ordinary sugar-nitrate broths without the addition of cured meat.

Water to Beat Frost

The Ministry of Agriculture recently quoted from "an interesting German broadcast" about frost damage and an old and simple remedy of sprinkling water over plants to protect them from frost. "Sprinkling with water by a hose or watering-can around sunrise to draw out the frost is not, it was said, the right thing to do. But the speaker said that when a modern sprinkling plant is used that distributes finely divided water over a large area at a time it has been observed that damage by frost has been prevented. A grower in New York State was quoted who twice saved his tomatoes in June and September of the same year by turning on his water and letting it run till sunrise. Another gardener turned on his sprinkling plant on going to bed actually to water them, not expecting a frost. To his dismay he woke in the morning to find his garden looking like a grove of stalactites. But the ice melted and not a plant was lost. It is important to note, however, that the broadcast ended by admitting that not enough is yet known to say for how long the sprinkling should be done, with what intensity, and whether it is effective in all cases, nor has any satisfactory explanation been given as to why sprinkling should have this result."

We were intrigued with the "grove of *stalactites*" and wonder whether the gardener in question looked at his garden upside down by walking, for instance, on his hands. We also deprecate any suggestion leading to the indiscriminate use of water, in view of recent B.B.C. broadcasts on the subject.

Horseflesh as Food

The use of horseflesh disguised with other foodstuffs was referred to in the House of Commons recently, and the Parliamentary Secretary of the Ministry of Food was asked to insist that the percentage of horseflesh in the articles offered should be stated. Major Lloyd George replied that he believed that that was provided for in the Food and Drugs Act. "There was no objection to anyone eating horseflesh if he wants to, but he must be made aware of the fact that he is eating it," he added amidst laughter.

It is possible that some of our readers may have forgotten that the new Food and Drugs Act, 1938, did not come into operation until after the outbreak of the war and that, in consequence, they have not studied the Act sufficiently. The present Food and Drugs Act is a consolidating Act, which will require adjustment in due course, but among other Acts, which have been repealed and included in the present Food and Drugs Act, is the Sale of Horseflesh, etc., Regulation Act, 1889, which has been incorporated into the new Act, Section 38. This Section prohibits the sale of horseflesh for human consumption except in a shop, stall, or place over or on which a notice in legible letters is displayed in a conspicuous position, so that it may be seen by purchasers. For the purposes of the Food and Drugs Act it is now usually assumed that when such a notice is displayed on the article, the customer has been advised, and it is therefore doubtful whether Subsection 2 need really be complied with. This subsection states that if anyone is supplied with horseflesh or a product containing horseflesh, if they have not asked for it, or if the product does not normally contain horseflesh, an offence has been committed. At the present time one may wonder whether it is advisable to label an article as containing horseflesh and then to advise the intending purchaser still further by verbal information.

Many food experts hold that horseflesh is preferable to beef as it is slightly sweeter, and it is the recognized practice to give horseflesh to consumptives in France, but prejudice is such in this country that one doubts the advisability of straining the nervous susceptibilities unduly.

Labelling Lore

Those whose duties include taking part in the selection of a new label for a canned product know how each participant in the discussion ventilates his own brand of psychology. In a recent book by Dr. W. E. Davis, *Congo Doctor*, he describes how those responsible for introducing a brand of canned corned beef into the Congo went astray in choosing the label.

For a long time the corned beef was refused because the most generally imported brand had the picture of a negro on the tin. The manufacturers thought that, since it was being sent to Africa, the negro on the label would be the natural thing, but the Africans thought differently. Even to this day there are many of them who insist that the contents of the tin are human flesh, and they point out with perfect logic that if the can which has the picture of the fish outside is full of salmon, therefore the can which has the picture of a man on the label must have human meat within.

Protein Needs

In an address given recently by Professor E. P. Cathcart, F.R.S., to the Food Group of the Society of Chemical Industry he dealt with the question of first-class protein.

It is easy, he said, to talk in an academic way about the quantity and quality of protein in the diet of the community. The question might properly be asked, "Do the members of the community in their daily lives accept these values?" They do not. Since the days of our grandfathers there has been a most commendable reduction in the amount of protein consumed among the well-to-do, but an increase among the poorer sections of the community, mainly in the form of meat.

Professor Cathcart had some interesting things to say about the necessity or otherwise of meat for those engaged in hard manual labour. He asked if it were possible that the small, if any, increase in the output of nitrogen in the urine, provided the energy needs are covered by an adequate supply of carbohydrate and fat, is not a real index of the metabolic changes which are taking place in the body. It will be agreed that it is highly improbable that any tissue can be in a state of extreme metabolic activity for considerable periods without exhibiting some kind of wear and tear, which normally would be indicated by a rise in the output of nitrogen. It is possible that the breakdown does take place, but the nitrogen does not appear in the urine because resynthesis has taken place. Or, on the other hand, is the demand for protein not in reality a demand for protein *qua* protein? Professor Cathcart discussed the *rôle* of extractives and quoted Thomas's experiments on the biological value of proteins, and his opinion that the extractives played an important part in their utilisation. He also reviewed other interesting phases of the subject about which so many diverging opinions are held.

A New Whey Product

The general restriction of milk and milk manufacturing to certain selected channels has resulted in the more or less complete prohibition of milk and dairy products in many branches of the food industry.

The elimination of cream production and the diversion of milk from butter-making to cheese-making has been followed by a complete absence of buttermilk and cultured separated milk in the baking industry. Various attempts to provide substitutes for milk for the baker have met with only partial success.

To meet the present conditions of scarcity a new dairy product quite indistinguishable from first-class buttermilk in flavour, acidity, appearance and general suitability has been produced by Professor D. Murray Smillie and Mr. Wight, of the West of Scotland Agricultural College, from fresh cheese whey. The product has already been tried out extensively in the baking industry, with particularly satisfactory results.

The special process of manufacture, which includes high-temperature treatment of the cheese whey, removes all traces of the cheesy flavour associated with whey, and gives a medium particularly suitable for the development of a most attractive and high-quality flavour and aroma in the finished product. These qualities greatly enhance the value of the fermented product, which should have wide commercial properties as a beverage.

In composition the new product compares favourably with separated milk, while a slight modification in processing gives a product approaching milk in total solids and containing an increased amount of protein.

In its sweet condition the new liquid may have many uses in the food industry. It has already been successfully tried in ice-cream manufacture in place of milk. The complete absence of casein makes it particularly suitable as a substitute for milk in milk shakes, as there is no fear of any curdling when mixed with fruit juices. There is reason to believe that it may well displace milk in the confectionery trade.

Optimum Calcium Again

This controversy has by no means been strangled at birth. *The Prescriber*, an old-established Edinburgh medical review, commenting on Dr. I. Harris's arguments against adding calcium salts to the proposed fortified bread, says: "Commenting on Sir John Orr's assertion that in about one-half of the population of this country the calcium intake is below requirements, Dr. Harris, of the Liverpool Heart Hospital, says (*British Medical Journal*, January 11, 1941) that he has been looking for cases of calcium deficiency in an extensive hospital practice, and latterly in an institution where normal people are examined periodically, but he has not found a single case. As Dr. Harris points out, the compulsory addition of calcium to the diet—*i.e.*, to bread—will mean that one-half of the population will suffer from hypercalcæmia with its attendant evil effects. They will be liable to develop arterio-sclerosis with its attendant heart involvement. 'There may be an indication for reducing the food calcium, but there is none at all for increasing it.'"

Dr. Harris has come back in another letter to the *British Medical Journal*, and still sticks to his guns. The layman is helpless in attempting to judge the matter, and his last reaction is, perhaps, a struggle between the fear of arterio-sclerosis and the effects of calcium deficiency. An easy way out of this dilemma would be to eat brown bread.

British Export Trade

In the House of Commons recently the President of the Board of Trade, in reply to questions regarding the Government's present attitude towards the encouragement, or otherwise, of oversea trade and regarding the raw material and labour available for export industries, said: "It has to be recognised that few exports do not in some way make a demand on resources such as labour, material, plant, and shipping space which are in heavy demand for the war. It is, therefore, necessary, as I have said on several occasions, and as the Industrial and Export Council recently repeated in a circular letter to all Export Groups, to apply a selective policy to exports and to encourage those which help the war effort. The tests are (1) whether the exports can earn or save exchange needed for the payment of essential imports; (2) whether, in the case of the sterling area or Allied countries, they are essential to the importing country; (3) whether the value of the exported product is high in relation to the imported raw material; and (4) whether the article can be manufactured and exported without putting an undue strain on resources needed for other war purposes. Subject to these overriding considerations it is the policy of His Majesty's Government to encourage exports and to maintain trade connections as far as the circumstances permit. I recognise that the booking of export orders is rendered very difficult by the need to apply these various tests, but my Department have given and will continue to give general guidance to the Export Groups to help them in answering enquiries. I am in constant touch with the other Departments concerned on the question of supplies of labour and raw material for manufacture for export."

Angry Farmers

There are many indications that the Ministry of Agriculture, through the Ministry of Food, are unnecessarily incensing farmers by their methods and manners, which savour too much of the policeman or even the Inquisition.

Food manufacturers are now dependent upon British and not foreign farmers for their raw materials, and British farmers as a class are loyal, patriotic and hard-working, not a whit less than industrialists.

It is natural, therefore, that they do not appreciate threats of imprisonment, nor do they feel heartened by menaces of a boycott of their products as a result of their exercise of trained discretion in sending produce to the buying centres of the Ministries. Such threats are not only empty and senseless; they are disheartening to the farmers and thereby inimical to the best interests of this country.

Unfair Advertisements

Some attention has been paid by the Ministry of Food to misleading advertisements. There is the case of those recommending the domestic manufacture of sugar from beet. The Ministry has given the following facts, which may well deter any prospective sugar boilers from trying their hand at the game: "100 lb. of sugar beet yields approximately 14 lb. of syrup containing 9 lb. of sugar. To obtain 9 lb. of sugar from sugar beet it is necessary to (*a*) plant 10½ square yards of land, and (*b*) wash and top 100 lb. of beet and to cut them into approximately 22,000 pieces, and (*c*) boil beet, which entails evaporation of nearly 9 gallons of water, with consequent heavy cost of fuel". We can visualise the sorry plight in which the neophyte would find himself if he had energy enough to go on with the job after the cutting operation was finished; the desperate requisitioning of every receptacle in the house; the frantic attempts at filtration; and the final sticky mess at the end.

We have noticed, among others, another type of advertisement which tends to give a wrong impression to those uninstructed in the elements of nutrition. It is one which compares a proprietary breakfast food with eggs and is signed "Doris Dodds". "It would take," she says, "3 eggs to give you anywhere near as much energy as a plate of Breakfast Food with milk and sugar. (Plate of Breakfast Food 220-230 calories, 3 average eggs 210 calories.) So you can see for yourself how much cheaper it is than eggs and bacon."

To a protest Doris Dodds might reply, "It's true, isn't it?" Quite so—about the calories—but she must know very well that eggs are not bought for their calories, and that, if it were necessary to advertise eggs, a comparison of their body-building contents with "breakfast food" could be made which would boost the relative cheapness of eggs sky-high. The general public is being educated in food matters at considerable expense, and such statements surely tend to neutralise the good work.

Reduction of Herds

The raising of the prices per hundredweight of 50, 51 and 52 per cent. cattle to figures nearer to those of the higher grades in order to encourage farmers to send more cattle to slaughter during the next few months is a Government measure, the repercussion of cattle raisers to which may be expressed in the words of Mr. George Gibbard, Chairman of the N.F.U. Livestock Commission, who broadcast on the subject recently. He said: "When we consider that the proportion of our annual pre-war importations of about eight million tons of animal feedings stuffs may be reduced almost to a vanishing point, and that a good deal of the increased production of our arable land may be needed as human food, I think we have no alternative but to agree reluctantly that the Government is probably acting prudently in telling us that some reduction is necessary." Mr. Gibbard mentioned the matter of cold storage and hoped that the Ministry of Food had not neglected to provide adequate cold storage in order that the home-produced meat supplies would not suffer unnecessary fluctuations.

The whole matter revolves upon an endless ring of circumstances. Due to reduced meat consumption bread consumption has increased. Increased bread consumption implies increased imports of wheat flour. On the face of things, it would seem that a certain measure of balance might be found by the rationing of bread, but it is difficult to visualise any reasonably quick reaction of such a policy upon the supplies of meat which would be available. If bread rationing resulted in the partial replacement by vegetables of the decreased ration, the result—dietetically—would be good. But even a casual examination of the food preferences of evacuated children forcibly stresses the fact that bread—mainly white bread—is the favoured food and that vegetables are almost anathema among the less prosperous classes of the community.

Vegetable Drying

From time to time during the past months references to the drying of vegetables have been made in the daily Press, and we have heard talk of the same in places where food scientists congregate. Some light was thrown upon the subject when Major Lloyd George was asked in the House of Commons "his plans for drying vegetables this summer". His reply was: "The expert advice I have received with regard to the drying of perishable summer vegetables is that so large a proportion of the food value of the resultant product is lost when any of the processes now operated on a commercial scale are employed, that further development on these lines would not be justified in existing circumstances. My Department is, however, keeping in close touch with the experimental work which is being carried out on this subject, and, should this work lead to improved technical methods, steps will be taken to develop them on a commercial scale."

We think it would be of advantage to have available for the use of food scientists outside the counsels of the Ministry of Food the results of researches hitherto carried out. There may possibly be some objections to this from the point of view of national interest, in which case we should be the first to support the obscurity which now seems to surround the subject. But what harm it would do for us all to know to what extent (say) vitamin C is destroyed in the drying operation we cannot imagine. We presume that the Parliamentary Secretary, Ministry of Food, was alluding to vitamin C when he mentioned food values. Vegetable drying on a commercial scale has been carried out in Holland since 1936, and, in addition to the powdered dried product, shredded compressed vegetables have been marketed in vacuumed tins.

In the literature issued in connection with these products no mention of vitamin C is made, and the conclusion seems obvious. Dried vegetables are, moreover, difficult to cook; they take a long time to resume their original volume and texture, thus exposing them to extra losses of vitamin C over and above those lost in drying.

It is probable that no problem is entirely insoluble, and it would doubtless guide interested scientific workers to know exactly the present state of knowledge on the subject.

Fresh Water Fish

An excellent start appears to have been made in the utilisation of some of our native foods by the canning of an appreciable number of perch caught in Windermere, and it is expected that they will soon be on the market, packed six and eight in a tin, in tomato and oil.

We were told recently that the Ministry of Agriculture and Fisheries wishes to encourage the use of eels as food. We first heard this months ago and have since been wondering what has been done about it. They are certainly not available so far as we have been able to ascertain.

It would appear that in the case of such things as fresh-water fish, ordinarily not offered for sale through the usual channels, the difficulties of distribution may be solved by canning, as has been done in the case of Windermere perch. We should be interested to sample canned eels.

The Seven Curses

The number "seven" is proverbially a peculiar one. There were the seven bishops, the seven champions of Christendom, the seven wise men of Greece, the seven wonders of the world, and so on.

And now the retail confectionery trade has found that it is assailed with seven curses, or so Mr. H. E. Williams put it at a recent meeting of the Liverpool and District Sweet Retailers' Association, during which lively criticism of the N.U.R.C. Conference was made.

Mr. Williams moved that a letter be sent to the executive of the N.U.R.C., asking for an endorsement of the policy of fighting the seven curses—co-ops., church bazaars, canteens, cutters, club trading, chain stores and cinemas—and this was agreed upon.

THE SALMON

ITS LIFE HISTORY AND FOOD VALUE

Part I

ELLIOT B. DEWBERRY, M.R.I.P.H., M.R.San.I

FROM time immemorial the salmon has been regarded as the king of food fishes, doubtless on account of its comparatively large size, graceful appearance, shapely form, beautiful silvery colour and high nutritive value.

Mention was made of the salmon in the writings of ancient philosophers and historians, who enlarged upon its qualities and properties as an article of food. As early as the year 77 A.D. Pliny recorded that " in Aquitania the river salmon is preferred to all the fish that swim in the sea ". It was well known to the Romans, who, observing the amazing leaping abilities of the fish in the rivers of Britain, named it salmo, probably from the Latin *salire*—to leap. Salmon was served at the feasts and banquets in Rome held in honour of conquests, much to the delight of the epicures of those days.

The Atlantic Salmon

History relates that the Atlantic salmon (*Salmo salar, Linn.*) was plentiful in the rivers of Western Europe and the British Isles and was frequently referred to in early Celtic and Anglo-Saxon literature and ancient Irish manuscripts. In the Middle Ages considerable commerce in salted salmon took place between Scotland and England. Later, owing to adverse conditions, this valuable fish, which had been so plentiful and a common source of food supply, steadily decreased in numbers until finally it came to be regarded more or less as a delicacy and provided sport for anglers.

This species of salmon, however, abounded in the waters along the Atlantic shores of North America and was present in enormous numbers in the rivers from New York to the North of Labrador, providing a valuable staple food for the North American Indians, who, incidentally, held strange beliefs with regard to this fish. The very early settlers in America also caught salmon in large numbers and salted and shipped them to Europe.

As time went on and commerce and industry increased, mills and factories were erected near the eastern coast, and doubtless the trade wastes from these tended to pollute the rivers, making conditions unsuitable for the breeding and existence of the fish. This, together with the vast quantity destroyed, caused their numbers to diminish. Although to-day the Atlantic salmon is no longer of real commercial importance, there are still important fisheries in parts of Canada, especially Labrador, where they are frozen and shipped to Europe.

The position of the Atlantic salmon in commerce was taken by the Pacific salmon, of which there are five species. The range of these fish on the American coast is from Northern Alaska southwards.

The Pacific Salmon

Centuries before the white man visited North America the Pacific salmon were the principal source of food for the native population all along the coast of the North Pacific, and they carried on a flourishing trade with the inland tribes too. In the rivers the fish were shot with bows and arrows, speared or caught in reef nets and afterwards smoked or dried on wooden racks and stored for winter use. The Indians made a preparation called " Pemmican " by finely powdering the dried, boned fish, which was afterwards packed in hempen sacks.

The native fisheries, however, made little impression on the vast numbers of salmon migrating from the sea up the rivers to spawn. Later the white settlers commenced fishing the rivers on a large and improved scale, and gradually one of the most valuable commercial fisheries in the world was formed. To-day the salmon fishing industries of California, Oregon, Washington, Alaska and British Columbia represent " millions of dollars of investment and millions of output annually ".

Species of the Pacific Salmon

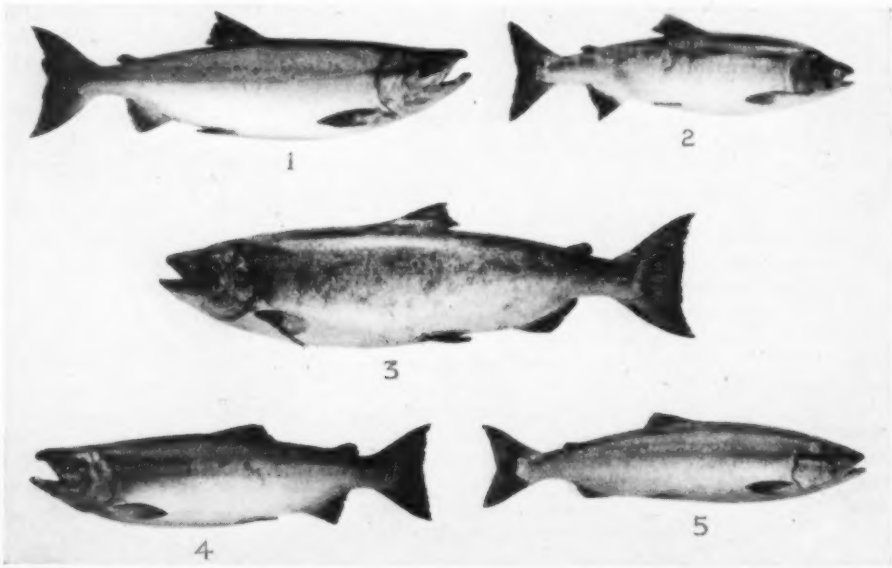
The five species of the Pacific salmon used in the commercial canning industry are mostly of large size and included in the genus *Oncorhynchus*. It is recorded that in 1731 the species were accurately distinguished under their Russian native names, and in 1792 Walbaum adopted them in compiling a scientific nomenclature (for these fish).

The salmon ascend the tributaries of the rivers to the North Pacific Ocean in America and Asia to spawn, and the eggs hatch out in the fresh water, but most of their mature life is spent in the sea (*anadromous*).

Each species has its distinguishing features and habits, thus :

1. Chinook (Columbia River); King (Alaska); Spring (British Columbia and on Puget Sound); Quinnat or Tyee salmon (*O. tschawytscha*).

This salmon, which matures in from three to eight years, is found throughout the region from the Ventura River, California, to the Norton Sound, Alaska, and on the Asiatic coast as far as



Species of Pacific Salmon.

1. Chum Salmon (*O. keta*).
2. Pink Salmon (*O. gorbuscha*).
3. Chinook Salmon (*O. tschawytscha*).
4. Coho Salmon (*O. kisutch*).
5. Sockeye Salmon (*O. nerka*).

Salmon attempting to negotiate a waterfall on the way to the spawning-beds.

Northern China. The largest of the five species, it has an average weight and length of 22 lb. and 38 in. respectively. The weight sometimes reaches 70 to 100 lb. The colour is silvery, with black spots on back, tail and dorsal fin, and the flesh is usually of a deep red colour. It is the only species caught in coastal waters practically throughout the year, and is of great commercial value.

2. Sockeye (on Puget Sound) or Red Salmon (Alaska); Blueback (Columbia River) (*O. nerka*).

When removed from the sea this species is of a clear bright blue colour on the back and silvery below. On entering the river to spawn, the colour of the head changes to olive and the back and sides to crimson. Average weight and length, 5 to 7 lb. and 28 in. respectively. The weight, however, varies in different localities. It matures from four to five years, has a high oil content, and the colour of its flesh and uniform size make it excellent for canning purposes.

3. Coho, Silver or Medium Red Salmon (*O. kisutch*).

This salmon is to be found as far south as Monterey Bay, where it appears in the month of July. It matures in from three to four years and has an average weight and length of 8 to 12 lb. and 28 in. respectively. The weight, however, may reach 30 lb. The colour is silvery, greenish on upper parts, with a few faint black spots on the back.

4. Humpback or Pink Salmon (*O. gorbuscha*).

Found in large numbers in the waters south-east of Alaska, this is the smallest and most numerous of the species. Bluish above and silvery below, with black spots on the upper part and a few large ones on the tail. The flesh is pale, hence its canned name " pink salmon ". It matures at the end of its second year. Average weight and length, 3 to 10 lb. and 24 in. respectively.

5. Chum, Keta or Dog Salmon (*O. keta*).

This has a wide distribution and is especially abundant from Puget Sound northwards to South-East Alaska. When first appearing along the coast it is of a dull silver colour and sometimes marked with small black specks. The sides show faint traces of gridiron-like bars, and the average weight and length is 8 to 16 lb. and 32 in. respectively. The flesh is light yellow. It matures in its fourth year and is especially suitable for salting, smoking or freezing.

THE LIFE HISTORY OF THE PACIFIC SALMON

In the spring millions of the fertilised eggs, which have been deposited under the sand and gravel of the streams and head waters by the female salmon, commence slowly to hatch out. The rate of development depends to a large extent on the temperature of the water prevailing during the winter and early spring.

The tiny salmon fry (alevins), like all salmonoids, have a fairly large yolk sac, which takes about a month to absorb. During this period they lie in the gravel at the bottom of the streams, being practically incapable of movement. Later, as their swimming abilities develop, they commence to move around the spawning-grounds in shoals, seeking food, which consists chiefly of small crustacea and insect larvæ.

Natural Enemies

The mortality of the fry at these stages is considerable, as they are an easy prey to a host of enemies, which include the char, Dolly Varden trout, squaw fish and sculpins, as well as certain birds. It has been calculated that, in the case of the pink salmon, of every hundred eggs only ten of the resultant fry survive to reach maturity.

The young salmon, whose growth is rapid, especially in the case of the Coho and spring salmon, gradually begin to descend the rivers, stopping for various periods in the pools and lakes where suitable food is plentiful, but continually moving towards the sea. The period of their stay in the fresh water varies with the location of the spawning-grounds and the particular species of salmon, as follows :

Chinook or Spring Salmon.—The fry either migrate to the sea shortly after hatching or in the following autumn. They may, however, stay for two years in the fresh water.

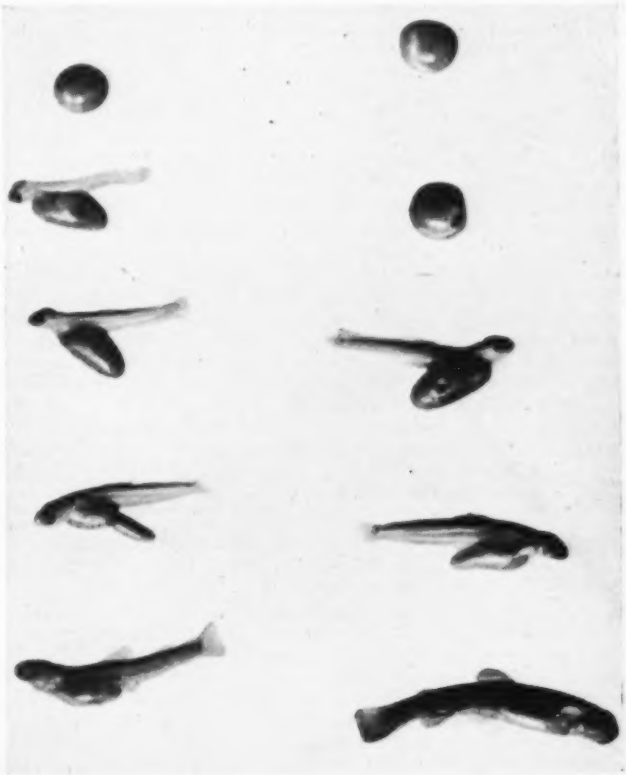
Pink or Humpback Salmon.—The eggs hatch out in streams not far from the sea. The fry are deep blue to greenish in colour on the back and silvery below. When about 1¼ in. long they migrate in February or May, so that there is practically no residence in the fresh water.

Chum Salmon.—The fry, which migrate to the sea in the first spring, are long, slim and gracefully shaped. The colour is dark mottled green with small black spots on the back and silvery below, and exhibit a pale green iridescence. They have six to ten oval " parr " marks on the body above the lateral line.

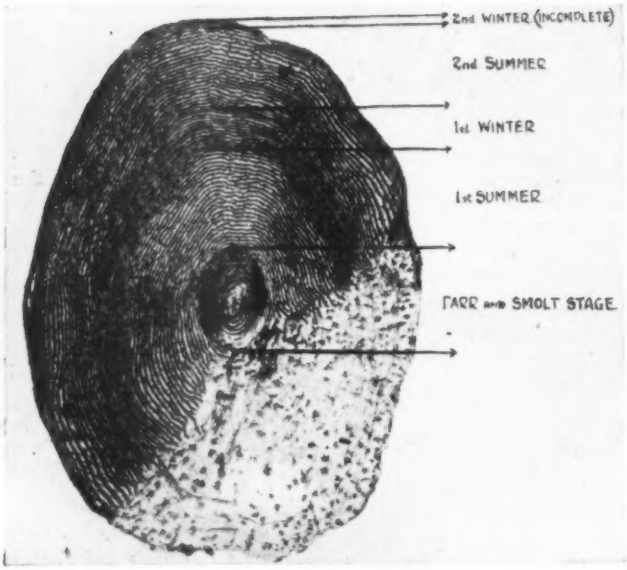
Sockeye Salmon.—The period of residence in fresh water varies considerably. Some of the salmon migrate to the sea in the following spring (yearlings are 3 in. to 5 in. long), while others remain for two, three or even four years in the fresh water. Sockeye are distinguished from Chum fry by the " parr " marks, which are more evenly distributed. There is no green iridescence and the back is not mottled.

Coho Salmon.—The fry and fingerlings are present in most of the springs and lakes of the Pacific coast. Many migrate to the sea as fry, fingerlings or yearlings, but some remain in the fresh water for two years. The fry possess large vertical " parr " marks which extend almost as far below the lateral line as above it.

All the five species of salmon, on reaching the sea, disappear. Recent researches have shown, however, that the vast majority remain comparatively near the coastline, whilst others stay in the bays, straits and sounds practically all the time, but not in the rivers.



Salmon eggs and fry showing yolk sac (*after Hutton*).



Salmon Scale. The lines on the scale show that the salmon has spent two summers and one complete winter in the sea. The lines of the second winter are incomplete, indicating that the fish is about four years old.

The food of the adult salmon varies with the species. Coho and Spring salmon live almost entirely on herring, pilchard, sandlance, smelts, squid, etc. Sockeye, Pink and Chum feed largely upon plankton, crustacea and sometimes small fish.

Ascertaining Age of Salmon

As a result of scientific research, it has been found possible, by examining the rings on the scales of a salmon, to determine accurately how long it has stayed in the fresh water, how long it has lived in the sea, and its age when caught. Scale-reading has proved invaluable in elucidating the life history of the salmon.

The young fry have no scales, but these commence to form at an early stage and continue to increase in number with the age of the fish. Each scale is embedded in a skin pocket, and these are arranged in rows which slope upwards and downwards from the median line towards the tail. If the scales are examined under a low-power microscope it will be observed that each is made up of a number of rings arranged concentrically like those on a target.

Hutton remarks: "On examining the scale, one will find that the rings are divided into alternate series of wide-open and narrower rings, which latter give the effect of darker bands. The wide rings are formed during the summer, when feeding is good, and the narrower rings on the approach of winter, when there is less feeding or none at all. Therefore by counting the number of summer zones and winter bands one can ascertain the age of any salmon with absolute accuracy up to a certain period of its life. The scales grow by the addition of rings around the circumference, in the same manner as rings are formed on a tree. There is, however, a difference—that a varying number of rings are added every year—certainly not by counting the rings".

When a salmon returns to the fresh water to spawn the scales wear away and the edges become irregular.

The Return to the Rivers

The salmon, after remaining in the ocean for a period ranging from two to six years (varying with the particular species), are compelled by sexual impulse to return to the fresh water to spawn. During their lengthy stay in the sea they feed upon rich and abundant food, and consequently are in prime condition, exhibiting the graceful form and familiar characteristic silvery colouration. They gradually approach the mouths of the rivers in enormous numbers. The time of the year and the number of "runs" (as migration from sea to spawning-beds is called) varies with the species, the locality and the character of the river to be ascended. There may be one, two or three runs, and these usually take place in the spring and the fall of the year. They occur regularly every year with each of the five species of salmon.

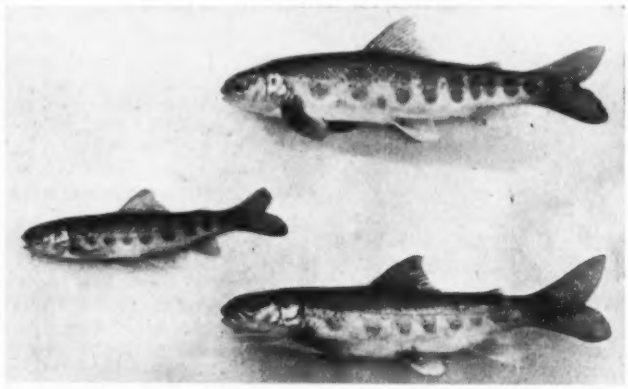
Salmon return to the stream from which they migrated to the sea, and frequently to the small tributaries where they were actually born. They travel enormous distances to reach the head waters and spawning-grounds, where the sand and gravel protects their eggs. The energy stored up in their bodies in the form of fat enables them to undertake these strenuous journeys. While in the estuaries their ascent may be helped by the tide, but higher up they have to make their way unassisted, and so great is the urge for reproduction that they will display immense perseverance in negotiating obstacles such as weirs, falls, etc. They swim (at about seven miles an hour) in crowded schools, and during these "runs" enormous catches of salmon are made by one or other of the following methods: gill nets (drift and set nets), haul and purse seines, diver nets, dip nets, squaw nets, reef nets, traps or pound nets, and trolling.

The gill net is the oldest and most popular form of apparatus in use; each year trolling is of increasing commercial importance.

The Dominion Department of Fisheries, which administers the fisheries of the province, regulates the fishing apparatus so that the salmon may reach the streams in sufficient numbers to ensure adequate seeding of the spawning areas and the maintenance of future "runs".

Spawning

As the time of spawning draws near, well-marked changes occur in the external appearance of the fish, due to abnormal physiological conditions while fasting and transferring substances from the muscles to the genital glands. The female loses her silvery colour, which is replaced by a dull reddish tint, and the body becomes spongy and slimy. The scales partly sink into the skin, and the flesh is pale and watery. In the males the snout and jaws are prolonged, the lower jaw being turned upwards at the tip to form a prominent hook. The jaws either shut like a pair of shears, or else the mouth cannot be closed. The body becomes spotted and mottled with red and orange, and black spots edged with white also develop. In some species of salmon there is a distinct hump on the back.



Salmon fry and parr (*after Hutton*).

The female salmon, accompanied by the male, who protects her from other fish, on reaching a suitable spawning-ground, deposits a batch of eggs in a shallow trough in the gravel, which she scrapes out by the movement of the posterior half of her body, tail and fin. These are promptly fertilised by the milt from the male. The process is repeated at short intervals until all the eggs have been extruded. Usually not more than half of these are fertilised, and they gradually become covered with gravel and sand to a depth of about 2 ft.

The translucent eggs, which are of a light yellow, orange or pink colour, vary from one-fifth to one-quarter of an inch in diameter and number from 2,500 to 5,000 per female, depending on the size and weight of the species of salmon.

No Pacific salmon spawns more than once in its life, and all die within a short time of spawning.

Artificial Culture of Eggs

In order to maintain the supplies of any particular species of salmon for the fishing areas, the artificial culture of salmon eggs has developed into a large and constantly expanding industry. The U.S.A. Bureau of Fisheries operates well-equipped hatcheries, while the State Governments of California, Oregon and Washington and the Dominion of Canada and the Province

of British Columbia have also built and maintained a considerable number, and some of these are among the largest in the world. The eggs and milt used for artificial propagation are obtained from salmon taken on their way upstream to the natural spawning-grounds. Hundreds of thousands of Pacific salmon are hatched and later released into the streams where they are most needed.

Food Value

The Pacific salmon breeds prolifically. It is caught in large quantities, can be satisfactorily preserved, is highly nutritious, easily digested and cheap; hence its value as a food. One of the best sources of protein (tissue-building material) both in quality and quantity, it possesses, in addition, other necessary factors which go to make up a well-balanced diet. At the same time it brings the flavour of the sea and health-giving qualities to the table.

Salmon are in prime condition when schooling in the salty coastal waters prior to their entering fresh water for the spawning migration.

The following table shows the average analyses of the five species of canned salmon:

Name.	*Total Solids. Per Cent.*	*Fat. Per Cent.*	*Protein (N X 6·25). Per Cent.*	*Ash (Inorganic Matter). Per Cent.*	*Food Value Per Pound. Calories.*
Sockeye ...	35·22	11·22	20·80	1·23	860
Chinook...	36·83	15·72	17·67	1·21	991
Coho ...	32·51	8·49	21·08	1·24	750
Pink ...	30·20	6·99	21·40	0·76	696
Chum ...	29·96	6·69	20·67	1·02	524

The oil in canned salmon contains the important vitamins A, D and B_2. It has been shown that the amount of vitamin D is as large as that contained in high-grade cod-liver oil, thus making the food suitable for growing children and for the well-being of the adult human body.

Salmon is particularly rich in mineral salts (calcium, phosphorus and small quantities of iron, copper and manganese), and also contains an appreciable amount of iodine. Chum and Pink salmon contain more than ten times as much iodine as meat, milk, eggs, cheese or most fruits and vegetables.

The systematic use of sea foods which are rich in iodine has been recommended in the treatment and prevention of simple goitre. Canned salmon, on account of its cheapness and availability, would doubtless be beneficial if included in the diet of patients under treatment for this complaint.

The bones of canned salmon are soft and edible and help to supply any lack of calcium in the modern diet. It is present in the proportion necessary for building sound bones and good teeth.

No fish is so extensively canned or is held in such high esteem as the salmon, and there is no doubt that it is an excellent food in summer, especially for people of sedentary habits and invalids. It would, of course, be of immense value in times of national emergency.

AVERAGE COMPOSITION AND FOOD VALUE OF SALMON COMPARED WITH VARIOUS TYPES OF FOOD MATERIALS.

Food Material.	*Total Solids.*	*Fat.*	*Protein (N X 6·25).*	*Ash.*	*Carbohydrates.*	*Calories Per Pound.*
Salmon ...	36·4	13·4	21·6	1·4	...	965
Beef, round ...	33·3	9·0	23·0	1·3	...	805
Hens' eggs ...	26·9	11·7	13·7	1·0	0·5	760
Potatoes ...	24·5	0·2	2·0	1·0	21·3	440
Cows' milk ...	12·6	3·7	3·4	0·7	4·8	310
Cabbage ...	10·0	0·2	1·9	1·2	6·2	170

The following figures show the quantity and value of canned salmon imported into the United Kingdom during the years 1934-1938:

Year.	*Quantity (Cwt.).*	*Value (£).*
1934	1,164,184	4,440,927
1935	1,003,990	3,886,695
1936	1,046,956	4,125,312
1937	1,177,444	4,480,581
1938	1,152,335	4,628,322

BRITISH STANDARDS IN WARTIME

SOME months before the outbreak of war the British Standards Institution, which is the recognised centre for the promulgation of all national British Standards, offered H.M. Government the services of the Institution, as a complete unit, in the national emergency. This offer, which was sent to the Board of Trade through whom the B.S.I. receives its Government grant, was most cordially received, and the various Departments of State were duly informed of the proposal.

On the outbreak of war the B.S.I. realised that its peace-time procedure was inadequate to deal effectively with the demands imposed by the changed conditions, and especially by the need for rapid action. A number of small executive committees were therefore set up for the various sections of its work, these being made fully responsible for the preparation of any War Emergency Specifications the Institution might be called upon to undertake. Under this emergency procedure the executive committees were given authority to restrict the usual wide consultation of industry to those interests directly concerned, and the reduction of the time usually given for comment on draft standards. It is, of course, understood that any British Standards issued under war-time procedure will come under review directly peace comes again.

Government Departments are employing the B.S.I. machinery for the preparation, co-ordination and promulgation of War Emergency Specifications to meet their several requirements, that policy being adopted because of the great experience of the Institution in this field and because it provides a most effective liaison between them and almost all branches of British industry.

The B.S.I. is invited to send a representative to appropriate meetings of the Materials Committee of the Production Executive, which is representative of all Government Departments, the Central Priority Department acting as the liaison between that Committee and the Institution. This has brought the B.S.I. in close contact with the increasing number of Departments working to specifications, and is thereby bringing about a considerable measure of co-ordination in their preparation and issue. In addition to the foregoing, the B.S.I. are collaborating with a large number of other industrial bodies, one example of its work being the rationalisation of alloy and special steels. In connection with exemption from purchase tax it has provided H.M. Government with definitions which give the dividing line between a number of commodities.

This war work has in no way prevented the B.S.I. from maintaining its usual close relationship with the Dominions' standardising bodies, which have been kept in close touch with these developments.

Correspondence

RUSTING OF TINS

TO THE EDITOR OF FOOD MANUFACTURE

DEAR SIR,—We have noted with interest your reply to the enquiry regarding the prevention of rusting of steak-pudding basins, which appeared on page 121 of your paper for May 3, 1941.

Ordinary untreated tinplate is not a very suitable material for these containers, owing to the porosity of the coating. Even with the better grades of tinplate there will still be quite a large number of discontinuities in the coating where the tinplate has been deformed at the rim. This porosity can be overcome by re-tinning the basis immediately after manufacture, either by hot-dipping or electro-deposition. Hot-tinning should be carried out preferably by the grease process, and your correspondent could get new grease-tinned basins from several firms. Re-tinning could also be done by the same firms. We could hot-tin a few samples for test purposes free of charge.

Electro-tinning with a thick coating of tin (0·001 in. or more) should also give good results, and we should be pleased to plate a few samples for your correspondent to test. If the results were satisfactory we could suggest the names of some platers able to do the work.

We agree entirely with your opinion that a lacquer would not be of much use in this case.

Yours faithfully,
C. E. HOMER,
Technical Development Officer, Tin Research Institute.

THE ELABORATION OF CATTLE FOR CANNED MEAT AND BY-PRODUCTS

Part II

T. CROSBIE-WALSH, F.I.C.

THE process of curing or pickling still has its problems, although many of the obscurities surrounding its mechanism have been cleared up by research.

What Saltpetre Does

In Part I of this series passing reference was made to the *rôle* of saltpetre, apart from its action on the hæmoglobin of the meat to produce the characteristic colour of pickled meat—fresh or canned. It appears to have bactericidal properties during the pickling operation, according to recent researches on the subject. One of the latest communications is that of L. B. Jensen and W. R. Hess in a paper read at this year's National Canners Association Convention, an abstract of which is published in this issue. It has been found that the presence of nitrate in the cure is of benefit in preventing the putrefactive anaerobes from growing in comminuted canned ham and luncheon meats. When spores of *Cl. sporogenes* are heated in the presence of permissible amounts of sodium nitrate it is possible that heat injury of spores results, so that a lower temperature may be used than is called for in the classical sterilising schedule. This phenomenon is still being studied by Dr. E. J. Cameron, but, according to the authors, both theory and practice of curing meat and canning cured meats teach that nitrate is an invaluable ingredient and, for most cures, should not be omitted.

It may be, then, that it will be found that the presence of saltpetre, even in the relatively small quantities used in pickle, has an effect that will enable the canned meat to be sterilised at a lower temperature than otherwise. It is doubtful whether this, in practice, would constitute a great advantage. Incidentally, the economy of steam would be negligible. As regards the effect of temperature on the final pack, although there can be detected a difference in texture in meat processed at 212° F. and 240° F., it is not so remarkable as might have been expected, so that a few degrees more of sterilisation heat are not inimical to quality.

Moreover, except in the case of tongues, the tendency in large-scale plants has been more and more to abandon cold pickling, the bacterial flora of which is perpetuated from lot to lot, and recently even pickling at all.

Keeping Properties of Finished Product

With regard to the effect of saltpetre on the keeping properties of the canned meat *after* it has been removed from the container, from the results of the author's experiments it appeared to be negative, as mentioned in Part I. The point is not a very important one, as the product is usually consumed before it has the opportunity of going bad, but there may be times, especially in hot weather, when the grocer, without cooling facilities, may have to keep canned meat over from one day to another. In any case, the meat canner cannot but welcome any device which will tend to render his operations safer, and if, as a result of the experiments now being carried out, saltpetre is definitely found to be one link in the chain of safety, there would be no particular difficulty in using it. In the hot process of pickling there would be practically no decomposition of nitrate to nitrite, and only that saltpetre which has been absorbed by the meat and that lost mechanically would have to be replaced as the pickle is used, added nitrite being relied upon for the colouring.

Handling of Pickle

The preparation and "reconstitution" of pickle used in the hot process may be carried out in different ways. A typical installation is here described.

Water passes through solid salt in a tank fitted with baffles, and a measured quantity of the resulting saturated solution, after having been filtered, is run into the "pickle preparing tanks" and mixed with a measured quantity of water. These tanks are provided with steam coils by which the pickle is sterilised by boiling. The composition having been adjusted, the pickle is passed to other tanks, where final samples are taken to be tested for nitrite and salt. There is a small filter press between the mixing and final tanks, from which the supply is drawn for the pickling tanks. When starting up work it is water that is mixed with the saturated salt solution, but after one day's pickling operation all the used pickle is pumped back to the mixing tanks to receive the new supply of salt and nitrite to make up for that which has been absorbed by the meat.

Pickling the Meat

The hot meat from the cooking-room is immersed in pickle which is at a temperature of about 80° C. The average time of pickling is 15 hours, and care is taken that the final temperature of the mixture of meat and pickle at the finish of the pickling operation is not less than 50° C.

The average proportion of pickle used is 70 to 80 per cent. of the meat (calculated on the raw meat), and the amount of used pickle drawn off the pickled meat is around 50 per cent. The "loss" is made up each day with fresh additions of salt solution and nitrite.

The salt content of the pickle is adjusted according to the desired salinity of the finished product. For corned beef it ranges from 8·5 to 10 per cent. (grams per 100 ml.), and the nitrite added is from 0·5 to 1·2 gm. per litre. The salt content of the finished corned beef is from 2·75 to 3·25 per cent.

In Table I are given some typical data from actual practice, taken over a few days' work.

From the tabulated figures arise some interesting considerations. It will be seen that the total creatinine and creatine, after making a jump upwards, as would be expected, during the first three days, gradually settles down to a maximum figure,

TABLE I

Pickle Ready for Use.							Used Pickle Obtained.					
Beef, Raw (Kilos).	*Litres.*	*Times Used.*	*Hydrometer Reading (Baumé).*	*Salt (Per Cent.).*	*$NaNO_2$ (Per Mil.).*	*Salt in Corned Beef. (Per Cent.).*	*Litres.*	*Total Solids, Less Salt (Per Cent.).*	*Salt (Per Cent.).*	*Total Creatine and Creatinine (Per Cent.).*	*$NaNO_2$ (Per Mil.).*	*Acid as Lactic Acid. (Per Cent.).*
48,863	35,200	Fresh	8·0	8·0	0·5	3·40	24,450	1·17	6·3	0·093	0·23	0·081
48,678	35,500	1	8·9	8·8	0·5	3·01	24,750	1·97	5·8	0·144	0·21	0·144
50,019	36,300	2	9·0	8·5	0·5	3·10	25,250	2·24	5·8	0·162	0·20	0·155
48,243	36,300	3	9·0	8·4	0·5	3·16	24,500	2·32	5·9	0·164	0·22	0·139
49,049	36,300	4	9·1	8·4	0·5	2·87	24,250	2·52	5·7	0·165	0·19	0·149

which demonstrates that the leaching of the extractives of the meat does not go on progressively. The same applies to the dry substance.

It is quite possible that some similar effect might be noted if it were possible to use the blanching liquors for vegetables over and over again, and thus mitigate the loss of vitamin C involved in this operation.

Use of Nitrite

When 1·2 gm. per litre of sodium nitrite is used, the amount taken up by the meat during the pickling operation is about 60 per cent., whereas, if only 0·5 gm. per litre is used, about 80 per cent. is utilised. So that, for safety's sake, 0·5 gm. per litre of nitrite in a pickle solution should be the minimum employed.

The amount of nitrite in the unsterilised meat (samples taken from the cans) ranges from 100 to 300 parts per million, but during processing most of this is destroyed and only from 9 to 17 parts per million are left in the final product.

From several points of view, it is advisable to keep an eye on the acidity figure and also the formol titration, as they are an indication of any accident that may happen to the pickle, such as undue cooling and consequent bacterial action.

Failing the use of thermostats, the temperature, if it falls too low, must be adjusted by hand, and the testing of the pickle constitutes a good control over night work. For adjusting temperature the pickle vats are fitted with steam coils.

The pickle may be used over and over again, but, owing to the weekly one-day holiday (during which time a large part of the factory is occupied in finishing the by-products of the canning section), it would be necessary to keep near boiling point a large quantity of pickle in order to prevent it from going sour; it is usually run away. From the standpoint of economy it is, of course, the striking of the balance between the cost of steam required to maintain the liquors at the requisite temperature, the cost of supervision, and the value of salt and nitrite sacrificed; but there are other considerations to be taken into account, such as inspection and repair of tanks and so on.

Colouring of the Meat

The influence of the composition of the pickle, length of pickling time, and the many other factors upon which the final colour of the canned product depend are very complicated. There is no "standard" pink colour. It is only in the United States of America that the matter of "consumer preference" has been taken up with any seriousness; elsewhere these matters are handled by conferences of sales managers and others in a particular organisation. This leads to many differences of opinion, and the switching over from one shade of colour to another during a season in which some 40 tons of meat are treated per day is an annoying business, to say the least, for those who are responsible for the manufacturing side.

The red colour produced in raw and cooked meats is one which has received the attention of a large number of investigators.

Historical Survey

Weller and Riegal (1897), in the examination of a number of samples of American sausages, obtained a red colouring matter on extracting the samples with alcohol and other solvents, which colour they concluded to be due to the action of the salts used in curing upon the natural colour of the meat. On account of similarity of spectra, this colour was considered to be methemoglobin. Lehmann (1899) observed that when fresh meat was boiled in water containing nitrites and free acid or old meat broth the surface of the meat turned bright red in colour, in contrast with the brown colour of fresh meat boiled in plain water. The addition of nitrates to the water did not give the red colour, which was found to be soluble in alcohol and ether and to give a spectrum showing an absorption band just at the right of the D line, and a second band, often poorly defined, at the left of the E line. On standing, the colour of the solution changed to brown and gave a spectrum of alkaline hematin.

Kisskalt (1899) studied the production of red colour in fresh meats on cooking, and found that this colour appeared when meat was cooked in bouillon which was several days old, or in water containing nitrites and free acid. Meat boiled in water to which saltpetre had been added did not take on the red colour; but if the meat was first allowed to stand several days in contact with saltpetre and then boiled, the red colour appeared.

Haldane (1901) made an extensive study of the colour of cooked salted meat, which colour he concluded to be due to the presence of nitric-oxide hæmochromagen resulting from the reduction of the colouring matter of the uncooked meat—nitric oxide hæmoglobin (NO-hæmoglobin). This colour was found to be the same as that resulting from the boiling of fresh meat containing nitrites and free acid. Orlow (1903) states that the red colour of sausages is due to the action upon the colour of the fresh meat of nitrites, resulting from the reduction of the saltpetre used in curing.

Hoagland (1908) studied the action of saltpetre upon the colour of meat and found that the value of this agent in the curing of meat depends upon its reduction to nitrites and nitric oxide, with the consequent production of NO-hæmoglobin, to which compound the colour of salted meats is due. Saltpetre was found to have no value as a flesh-colour producer.

Glage (1909) is the author of a pamphlet giving practical methods for producing the best results in the curing of meats by the use of saltpetre. As early as 1812 Humphry Davy, and later Hoppe-Seyler (1864), noted the action of nitric oxide on hæmoglobin, but it appears that Hermann (1865) was the first to furnish us with much information as to the properties of this derivative of hæmoglobin.

Recent Research

Recently W. M. Urbain and L. B. Jensen have published (*Food Research*, **5**, 6) a very complete account of their investigations on the heme pigments of cured meats, carried out in the research laboratories of Swift and Company, Chicago.

In passing, the highest tribute should be paid to the American custom of freely giving to the world in general, and meat chemists in particular, the results of costly research sponsored by commercial firms.

Urbain and Jensen review the work carried out since that of Haldane and Hoagland, and mention that since then the existence of a red pigment different from the blood pigment hæmoglobin has been demonstrated by Gunther (1921), Kennedy and Whipple (1926), Hektoen, Robscheit-Robbins and Whipple (1928), and Theorell (1932, 1934). Haldane and Hoagland assumed the pigment of meat to be identical with the blood pigment. Determination of the amounts of the muscle hæmoglobin or myo-hæmoglobin by Shenk, Hall and King (1934), and by Watson (1935), occurring in the muscular tissue of several animals, indicated that this pigment comprises nearly all of the tissue pigment. Since the slaughter of animals by modern methods includes a bleeding process which removes most of the blood, it is suggested that, in the light of the isolation of the muscular pigment, the pigments of cured meats are not essentially nitric oxide hæmoglobin and nitric oxide hæmochromogen, as they have been called in the past, but instead are chiefly nitric oxide myo-hæmoglobin and nitric oxide myo-hæmochromogen.

Urbain and Jensen, in the introduction to their paper, state that, while it is recognised that the true meat pigments are mainly derivatives of myo-hæmoglobin, it was the purpose of their investigation to study in systematic fashion the nitric oxide derivatives of hæmoglobin itself, since it is easy to obtain hæmoglobin in sufficiently large quantities; whereas the difficulties of isolation of myo-hæmoglobin are considerable. The close relationship between the two pigments hæmoglobin and myo-hæmoglobin permits the correlation of the properties of hæmoglobin derivatives with those of meat pigments.

The authors, after discussing the different methods of curing, say that all these processes eventually lead to the formation of nitric oxide myo-hæmoglobin, according to the reaction:

NO Myo-hæmoglobin = Nitric Oxide Myo-hæmoglobin.

The source of the nitric oxide is nitrous acid, since the pH of meat is normally on the acid side—about 6. By heat the nitric oxide myo-hæmoglobin is converted into nitric oxide myo-hæmochromogen.

Preparation of Nitric Oxide Haemoglobin

The method of preparation of pure nitric oxide hæmoglobin is described, and its reactions and properties were studied on the pure substance. Very complete details of the work carried out are contained in the original papers, but a brief account of the main conclusions may be given here.

As a result of experiments on the pure substance, it was found that, as a meat pigment, nitric oxide hæmoglobin has several undesirable features. Chief among these is the ease with which it is attacked by atmospheric oxygen. However, there is one saving condition, that there is complete absence of any oxygen tension within meat; for this reason cured meat may be placed in air with only danger of surface oxidation and discoloration. The mechanism of the oxidation of nitric oxide hæmoglobin to

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GREEN VEGETABLES AS PROTEIN FOODS

It should not be beyond the powers of scientific workers to perfect an economically practical method of extracting protein, not only from vegetables normally eaten, but from herbage in general.

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GREEN vegetables are primarily " protective " foods. Their principal function in the diet is to provide vitamin C, vitamin A, a small amount of B_1, other members of the vitamin B complex, particularly riboflavin, and the minerals calcium and iron. This appreciation of the true place of green vegetables in the well-balanced regimen has largely developed since the last war, when parsnips and Jerusalem artichokes, assessed solely as providers of calories, were widely grown. While, however, we now know that the main function of vegetables is to supply vitamins and minerals, not calories, we must not let the pendulum swing too far and forget entirely the contribution which green vegetables might make to our supplies of protein.

The percentage of protein in green vegetables in the form in which they are usually eaten is low. Cabbage contains 1 per cent., cauliflower 1·5 per cent., brussels sprouts 2·5 per cent., and broccoli leaves 3 per cent. Boiled spinach, with 5 per cent. of protein, can provide a substantial addition to the diet when comparatively large helpings—say, 8 oz. or 225 gm.—are eaten. Although as a general rule, however, the absolute proportion of protein is low, in every case the " nutritive ratio " is very " narrow."

Nutritive Ratio

The useful term " nutritive ratio " is, perhaps, more commonly employed in stock-feeding than in human dietetics, but it forms a convenient method of comparing foods of different classes. The " nutritive ratio " is the ratio between the calories derived from protein and the carbohydrate and fat calories in a food. Since a well-balanced diet must contain about 20 per cent. of protein, any food with a " nutritive ratio " less than about 5 is adding protein to the diet. In agricultural feeding the " nutritive ratio " is a convenient figure for comparing a wet, bulky food such as grass with a dry and concentrated article—for example, linseed cake. Nowadays it is a particularly valuable constant when considering wet house scraps as a component of poultry diet. The cheap carbohydrate foods such as bread, flour and potatoes have " wide " nutritive ratios. It often comes as a surprise to realise that a green vegetable such as brussels sprouts has a " nutritive ratio " of 1 : 0·7, whereas haricot beans have a ratio of 1 : 2·5, and Cheddar cheese, which is often classed as a protein food, has a ratio of 1 : 3·2. While the " nutritive value " shows whether or not a food is acting as a protein source in the diet, it is still necessary to consider the absolute amount of protein which a given intake of any food provides. Although it may be shown that green vegetables contain good quality protein, of which of all factors our war-time diet may be in need, we cannot assume that sufficient of so bulky a food can be eaten to supply more than a part of the body's protein requirement. Can a consideration of some further aspects of the place of proteins in the structure of the plant help us to overcome this drawback?

Composition of Leaf Proteins

The composition of seed proteins has been under investigation for some considerable time. Ritthausen isolated phaseolin from beans in 1884, and since that time a long list of component amino acids has been worked out. The proteins in leaves, however, were for a long time neglected. In his monograph published in 1924, Osborne wrote that practically nothing was known of the chemistry of leaf proteins. Between 1924 and 1939, when Chibnall published his book on protein metabolism in the plant, a great deal of progress was made. The advances which Chibnall was able to make were due in a large part to improvements in technique. By the use of ether to destroy the impermeability of the plant cell wall he was able to separate from each other three protein fractions. In the green leaf the individual cell is enclosed by a cellulose wall and, in its simplest form, consists of a peripheral layer of living protoplasm surrounding a large vacuole or sap cavity. Within the general ground mass of the protoplasm, often called the cytoplasm, are embedded the nucleus, many chloroplasts and other minor inclusions. When leaves are treated with ether the cells collapse and the vacuolar contents can be pressed out through the cellulose walls. From the press juice of spinach, alfalfa and a very few other plants a small amount of " vacuolar " proteins can be isolated. The leaf residues can then be ground and filtered. A second fraction " cytoplasmic " proteins, comprising the bulk of the protein in the leaf, is isolated from the filtrate, while a small amount of nuclear proteins, together with the " chloroplastic " fraction, is held back by the filter. The constituent amino acids isolated by Chibnall from the three fractions of spinach are shown in the table.

AMINO-ACID ANALYSIS OF THE THREE CONSTITUENT PROTEINS OF SPINACH LEAVES.

(PERCENTAGE OF TOTAL PROTEIN-N.)

	Spinach Protein.			Cocksfoot Protein.	
	Vacuolar Protein.	Cytoplasmic Protein.	Chloroplastic Protein.	Per Cent. of Total Protein-N.	Per Cent. of Protein by Weight
Amide-N ...	5·8	5·6	5·1		
Arginine-N ...	11·2	14·1	13·9	15·5	8·2
Histidine-N ...	2·0	2·2	3·3	2·3	1·5
Lysine-N ...	7·3	6·2	4·7	6·0	5·3
Tyrosine-N ...	2·6	2·7	2·6	2·3	5·0
Tryptophane-N	1·4	1·7	1·7	1·8	2·2
Cystine-N ...	1·4	1·4	1·2	1·5	2·2
Methionine-N ...	1·1	1·3	1·3	1·3	2·3
Aspartic acid-N		5·5	5·8	4·9	14·3
Glutamic acid-N		6·5	6·5	8·0	7·9
Glucine ...				0·4	0·3
Alanine ...				4·4	4·8
Valine				4·2	6·0
Leucine(s) ...				8·8	14·0
Phenylalanine...				2·5	5·0
Proline				2·0	2·8

In order better to assess the value of these proteins for nutritional purposes, the fuller amino-acid analysis which is available for the combined proteins of the green leaf of cocksfoot grass has been listed beside the spinach proteins.

Indispensable Amino Acids

With regard to the indispensable amino acids, it has been found, in so far as they have been determined, that they are present in adequate amounts. Tryptophane and lysine comprising 2·2 per cent. and 5·3 per cent. of the total proteins compare favourably with the corresponding values of 1·3 per cent. and 6·2 per cent. for casein from milk, while methionine (2·3 per cent.) is a little lower. In the case of cocksfoot, which is probably fairly characteristic of leaf proteins as a class, the values for total leucine, phenylalanine and valine are high. From this evidence Chibnall comments that " the excellent nutritive value of the leaf proteins is thus very clearly evident ".

Although the chemical composition of green-leaf proteins gives good reason for the assumption that they are of high nutritive quality, clear-cut animal experiments to prove this point do not seem to be available. Since many grazing animals grow satisfactorily on an exclusive diet of herbage, it is certain that the protein is of adequate biological value for these species. Osborne and Mendel some years ago carried out biological experiments which apparently showed that a protein preparation from spinach was satisfactory for young rats. Experiments of this nature are complicated by the inadvisability of feeding the whole vegetable as a source of protein.

The Carbohydrate Fraction

The carbohydrate fraction of vegetables, besides comprising easily digestible starches and sugars, also includes compounds classed as hemicelluloses and fibre. These substances are bulky,

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A STUDY OF THE EFFECTS OF SODIUM NITRATE ON BACTERIA IN MEAT*

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ALTHOUGH the use of nitrates in meat curing is an old custom in the Western world, we are not certain that nitrates were used by the ancients for this purpose.

The statement has been made by Kerr, Marsh and Schroeder (1924) that saltpetre has been used in meat foods from very early times, and Hehner (1910) writes that the practice is so old that its origin is unknown.

There is no record of the first use for this purpose, but, as Tanner and Evans (1933) say, "it is known, however, that sausage has been cured with nitrate for over 100 years. Saltpetre has probably been used in other meat products for a much longer time".

From a careful study of the food of the medieval Norman-French, Scandinavians, English, Icelanders and Island Scotch, we can safely affirm the idea that nitrate-cured meat was unknown until the late Middle Ages. As Henry Adams (1928) writes: "The Normans were everywhere and everywhere in the lead of their age". Their foodstuffs represented the best of that age (911-1200), and the classic studies of Delisle (1851) do not indicate that other than salt-curing and smoking of meat was practised in the most civilised part of the world of that age.

With the advent of gunpowder and purified saltpetre in the thirteenth century, it is not difficult to conjecture a ready application of nitrates to salt-curing or preservation of meat, with the resulting fixed cured red colour (unheated=nitric oxide-hæmoglobin; heated=nitric oxide-hæmochromogen). Saltpetre was also used in medicine of late medieval times. There is no concise information, then, on the beginnings of salt-nitrate curing of meats, according to Rideal (1903).

Modern Concepts

In a paper published over thirty years ago, W. D. Richardson (1907) pointed out some surprisingly modern concepts of the rôle of nitrate in curing. He wrote: "It has been persistently reported that the sole object in using saltpetre in the curing of meats is for the purpose of maintaining a red colour. This is only one of the several objects gained in using the substance. That it is an essential curing agent, and that a large percentage of sour meats (in the trade sense) would result if its use were discontinued, cannot be successfully controverted. While it may be admitted that saltpetre is not an antiseptic in the sense ordinarily understood by this term, it appears to protect in some way the nitrogenous tissue against bacterial invasions. Possibly the most beneficial rôle of saltpetre in the curing of meats is its transformation of what would otherwise be *anaerobic conditions* into aerobic ones in the bacteriologic sense. . . . I need only say here that it has been shown that aerobic bacteria will develop in the absence of air if saltpetre is present in the culture medium, and that anaerobes refuse to grow in the absence of air and presence of saltpetre. The fact that typical putrefaction (*faulnis*) is an anaerobic process, and that this process can be transformed into an aerobic one by the presence of saltpetre, is a most important point in the curing of meat. . . . The amounts of nitrates found in vegetables are of the same order, but rather more in many instances than those found in cured meats. . . . As much as the equivalent of from 1 to 2 gm. of saltpetre daily could be consumed by a person eating fresh vegetables. Inasmuch as a fresh vegetable diet is entirely harmless and as no case of injury from saltpetre in cured meats is on record, saltpetre in the quantities used in cured meats must be classed as a harmless substance."

Decomposition of Nitrate

Nitrate, when added to the brine or pickle used to cure meats or added to sausage meats, does not "fix" colour until nitrate-reducing bacteria form nitrite, which in turn furnishes the "nitroso" or nitric oxide component for the permanent pink pigment of hæmoglobin (nitric oxide-hæmoglobin and, when heated, nitric oxide-hæmochromogen). These desirable pink pigments and their undesirable oxidised green or brown compounds were described by Jensen and Urbain (1936) (1940). The use of nitrite *per se* in curing meat is logically indicated, and on October 19, 1925, the Bureau of Animal Industry allowed the use of sodium nitrite in curing meats not in excess of ¼ oz. to each 100 lb. of meat. Not over 200 p.p.m. of nitrite were to be permitted in the finished product. This innovation resulted in more rapid cures for some meats.

Tanner and Evans (1934) write: "Saltpetre (sodium or potassium nitrate) has had the longest use in meat-curing solutions. Since nitrates must be reduced to nitrites, packers desired to use nitrites, as such, to avoid the dangers which might result from inadequate conversion of nitrates to nitrites. Losses from uneven or inadequate fixation of colour were not uncommon. Since many bacteria exist which may reduce nitrites, it is necessary either to add sufficient to fix colour before it is used up or to have a constant source of supply (nitrates). The nitrate cure permitted this, but the nitrite cure introduced the hazard of nitrite disappearance. Consequently, there may be much merit in the mixed cure in which both nitrates and nitrites are added."

The work reported in this paper was undertaken to determine the specific value of nitrate as a bacteriostat, inhibitor of bacterial toxigenicity, inhibitor of spore germination, and its effect on the anaerobic flora of cured meats and cannd cured meats.

Literature on Nitrate

Grindley, MacNeal and Kerr (1929) found, as have the practical meat packers, that a mixture of nitrate and sodium chloride gives better results in the curing of meats than does salt alone, and only a small quantity of nitrate need be employed in the mixture. They found that in acid solutions even small amounts of nitrate exerted a marked inhibitory effect upon bacteria. This effect was incomparably greater than that of the corresponding chloride, and is best ascribed to the production of a small amount of nitric acid, and of nitrous acid also, in mixtures containing reducing substances. Nitrate was, therefore, particularly effective in restricting acid fermentation of organic substances already slightly acid in reaction. There was definite evidence that nitrate was especially effective in restricting the activities of certain bacteria which are not readily prevented by strong sodium chloride solution.

Moran (1928) found that "sodium nitrate was specific in retarding the proteolytic activity of *Cl. sporogenes*. At the concentration of 0·5 per cent. $NaNO_3$ and 5 per cent. NaCl, the effect was very pronounced. Between the concentrations of 0·5 per cent. and 1·0 per cent. $NaNO_3$ in the 5 per cent. NaCl range proteolysis was completely checked, as in the latter concentration the Sorensen figures were scarcely higher than the control. The other determinations check these figures very well".

Tanner and Evans (1933), in a study of the effect of sodium nitrate alone on Clostridia, including many strains of *Cl. botulinum*, found that concentrations of nitrate from 2·2213 to 4·427 per cent. by analysis showed irregular inhibition of seven *Cl. botulinum* cultures. The highest concentration prevented growth of six out of seven, and toxin formation by five out of seven, of these strains. In a subsequent paper Tanner and Evans (1934A) showed that sodium nitrate alone cannot be relied upon to prevent growth and toxin formation by *Cl. botulinum* in cured meat. Concentration of $NaNO_3$ from 0·0588 to 0·3920 per cent. failed to inhibit *Cl. botulinum*, *Cl. putrificum* and *Cl. sporogenes* in either pork infusion or egg medium. These concentrations of $NaNO_3$ did not prevent toxin formation by *Cl. botulinum* in either egg medium or in pork medium. In another communication Tanner and Evans (1934B), after an exhaustive study of the effect of mixed curing solutions—*i.e.*, NaCl, $NaNO_3$, and $NaNO_2$—on anaerobic bacteria, concluded: "Commercial curing mixtures were effective in preventing growth and toxin formation when the proportions of curing mixture to medium were such that the critical concentrations of sodium chloride were approximated. The $NaNO_2$ present apparently produced no effect on these organisms (*Cl. botulinum* A and B, *Cl. putrifi-*

* *A paper read at the Thirty-fourth Annual Convention of the National Canners Association*, 1941.

cum and *Cl. sporogenes*). Spoilage of cooked and uncooked meat was not prevented by 3·5 per cent. NaCl in combination with 0·1 per cent. to 2·0 per cent. $NaNO_2$, or 0·01 per cent. to 0·2 per cent. $NaNO_3$ added to the meat. The repression of toxin formation by *Cl. botulinum* in uncooked meat was due to the acid reaction of the meat. None of the cures completely inhibited toxin formation by *Cl. botulinum* in cooked meat."

In our laboratory we have found that all cured meat hams, beef hams, bacon, etc., are very acid in reaction. Our analytical staff have never observed a quick-cured ham which was outside the acid range of *p*H 5·9 to 5·7. The old-style long-cured hams were *p*H 6·2 to 5·8. These acid ranges produce the inhibitory effects of nitrate on bacteria noticed by the University of Illinois group, Grindley *et al* (1929), and by the practical meat packers for many years past.

Nitrate Kills Clostridia

We have observed another mechanism in which nitrate actually kills *Clostridia*. The train of events is as follows: During the curing of meat with nitrate, salt (and sugar), the nitrate is often partially reduced to hydroxylamine (Lindsey, 1932). Hydroxylamine inactivities catalase in meat cures so that hydrogen peroxide is formed. This phenomenon has been observed by Jacobson (1892), Blaschko (1935), Keilin and Hartree (1934), Sevag and Mauveg (1936) and Locke *et al* (1938). McLeod and Gordon (1923) and McLeod (1929) found that hydrogen peroxide (produced by most bacteria) in the substrate will inhibit and kill Clostridia like *Cl. tetani* in such small amounts as 3 p.p.m., and that most bacteria produce H_2O_2. They state that anaerobes cannot tolerate more than slight concentrations of oxygen because they produce hydrogen peroxide as soon as oxygen is available. Being very sensitive to this substance, they are killed. According to Quastel and Stephenson (1926), the inhibitory action of hydrogen peroxide may be due to its effect on reduction potential rather than to direct toxicity. Stephenson (1930) observes that nitrate introduces oxygen into the substrate. The hydrogen peroxide in cures and cultures may be determined by the method of Main and Shinn (1938). In Thuringer sausage, Lebanon bologna, Essex sausage, pork rolls, etc., we must have nitrate present for the lactobacillus fermentation which produces the characteristic "tang" or flavour. Without nitrate present these products putrefy during cure. Jensen, Wood and Jansen (1934) found that omission of nitrate in curing chopped hams will result in a canned finished product which shows putrefaction upon incubation for 90 days at 99° F. It is an easily proved fact, and regularly observed, that nitrate-nitrite-sugar-salt cure favours most kinds of aerobic bacteria found in curing cellars, whereas nitrite-salt-sugar cure usually inhibits fermentation and aids in putrefaction.

Many bacteria usually regarded as aerobic are able to utilise the nitrates or oxygen more or less indifferently, according to Buchanan and Fulmer (1930). It is thought by some investigators and the writers that nitrates in the mixed NO_3-NO_2-salt-sugar cure tend to inhibit or delay germination of spores of the genus Clostridia, including *Cl. botulinum*. Chemists show that in cooked and heat-processed meat containing nitrite there is a reaction which causes the disappearance of nitrite in the finished product.

Some Beneficial Actions of Nitrate

In passing, we may mention some beneficial actions of nitrate in the curing of meat other than the bacteriological aspects: (1) nitrate acts as a reservoir of nitrite to fix the colour of meat—*i.e.*, to form nitroso- or nitric oxide myoglobin and hæmoglobin and their heated or salt-changed compounds, the nitroso hæmochromogens. (2) In mixed cures (NO_3+NO_2) the "colour forms" and "stands up", according to the curing men. If NO_3 is omitted from brine cure and the permissible amount of NO_2 is used, "burning"—*i.e.*, poor colour—is practically always observed. This specific subject has been discussed often at the Scientific Section of the American Meat Institute in convention. (3) NO_3 increases the permeability of meat fibres for water carrying other curing ingredients in the same manner as urea in slightly acid solution acts on meat. (4) Meat, especially hams cured with nitrite alone, when exposed to the air and light, tend to discolour rapidly.

Both theory and practice of curing meat teach that nitrate is a valuable ingredient of the pickle and for most cures should not be omitted.

Tanner (1932) writes: "While meat packers desired a nitrite cure a few years ago, results of extensive investigations indicate that, at times, a mixed cure (containing both sodium nitrate and sodium nitrite) is desirable from the standpoint of both spoilage and development of toxin by *Cl. botulinum*. The preserving effects of such curing solutions have been generally attributed to the nitrites, either those added as such or those secured by reduction of the nitrate; however, evidence has been recently collected which might indicate that the nitrate itself may have some value as a preservative. This position is suggested by the fact that curing solutions containing nitrate have shown preservative action, even though the nitrate reducers have been destroyed by the process."

Experimental Work

Canned Spiced Ham.—A great part of the data available to us appears to have been obtained from laboratory and culture tube experiments using nitrate, nitrite, salt, etc., and *Cl. botulinum* as the test organism. Such data are of the greatest value; but on occasion practical large-scale tests are needed to evaluate the practicability of the information. In plant tests the use of *Cl. botulinum* as a test organism obviously is forbidden, so we chose a strain of *Cl. sporogenes* which Dr. G. M. Dack designated as identical with *Cl. botulinum*, type B in biochemical and growth characteristics. This strain differed only in that it was atoxic. All workers in the bacteriology of botulism have probably observed *Cl. sporogenes* as a "contaminant" of *Cl. botulinum* cultures (Jensen, 1926; Tanner, 1933).

Canned spiced ham was chosen as a test meat product for studying the specific effect of nitrate and nitrite on certain spore-bearing members of the genera Clostridia and Bacillus. In other tests we likewise had to rely on small-scale lots of experimental material in culture tubes, etc.

The first experiment was conducted on specially prepared fresh ham trimmings as free as possible from bacteria, particularly gas-forming bacteria of the genus Bacillus. Twenty-four-hour ham trimmings were used. The spices added—coriander and white pepper—were sterilised. Two test batches of ham were made, each containing 400 lb. of trimmings. Each batch was chopped and then divided into two lots of 200 lb. each.

One lot of 200 lb. was cured with the regular curing ingredients for spiced ham—*i.e.*, 2 per cent. sucrose, 3·5 per cent. salt, 4 oz. sodium nitrate, ½ oz. sodium nitrite and 1 oz. mixed spices. The other lot of 200 lb. was cured with the same ingredients except that it contained no nitrate. To each lot during mixing, before stuffing, a culture of *Cl. sporogenes* (heated 20 minutes at 180° F.) was added so that each 6-lb. can would contain 10,000 spores. Samples for bacteriological analyses were taken after the curing ingredients were mixed with the ham trimmings, and samples taken again after 72 hours when the meat was cured. In addition, samples were taken after the meat was canned and cooked (5 hours at 155° F.). Table I shows the results of these bacteriological examinations:

TABLE I.—INOCULATION OF SPICED HAM IN NITRITE AND MIXED CURE OF NITRITE AND NITRATE.

Sample.	*Nitrite Cure.*		*Mixed NO_3 and NO_2 Cure.*	
	BACTERIA PER GRAM			
Ham Trimmings.	*Aerobic.*	*Anaerobic.*	*Aerobic.*	*Anaerobic.*
Fresh	95,000	*100	100,000	*100
After cure	115,000	†10,000	110,000	†10,000
After cooking ..	*10	8,000	*10	†10,000

* Less than. † About.

All of the 6-lb. cans of spiced ham were placed in the 90° F. incubator after the cooking and chilling processes were completed. The cans were incubated for the standard 30-day period and then opened for inspection. All 32 of the 6-lb. cans of spiced ham, cured without nitrate but containing nitrite, were organoleptically sound with no swells after 30 days. Thirty-two 6-lb. cans of spiced ham, cured with nitrate and nitrite, after 30 days' incubation showed 3 swells—2 swells in 6 days and 1 swell in 20 days. This comparative test indicates that nitrate induces gas formation, the mechanism of which has been described by Jensen *et al.* (1934).

A second 400-lb. batch of ham trimmings was handled in the same manner as described above—*i.e.*, divided into two 200-lb. lots and cured separately. The one lot was cured with nitrite without nitrate, and the other lot was cured with nitrate and nitrite. Salt, sugar and sterilised spices were, of course, added to both batches, and the meat was cured for 4 days. Before stuffing into cans in 6-lb. amounts each batch was inoculated with *Cl. sporogenes* so that each can contained *circa* 10,000 spores.

Of 32 cans of spiced ham cured with nitrite alone (all ingredients except nitrate) and incubated at 99° F., 19 cans of meat

were putrid, 9 cans were sound, and 4 cans were slight swells with both fermentation and proteolysis. Thirty-two cans of spiced ham cured with nitrate and nitrite, as well as other ingredients, and then incubated at 99° F., showed : 20 sound cans, 5 swells due to fermentation of genus Bacillus, and 7 putrid cans of meat.

These tests indicate that nitrate in the cure is of benefit in preventing the putrefactive anaerobes from growing in regular spiced canned ham. We consider the laboratory inoculation of spores into these lots of meat to be larger than occurs spontaneously in the product. The swelling of cans, which results from growth of the genus Bacillus in nitrate, sugar and cured meat, serves as an index of handling these products. Mishandled cans of spiced ham cured with nitrate will often swell, which should serve to warn the consumer; whereas a nitrite-cured can of meat may not swell under such conditions. We must always bear in mind that nitrites react with protein when heated, and the nitrites are destroyed to a large extent, thus leaving the meat in much the same state as ordinary fresh-cooked uncured meat. It is well known that the latter product spoils quickly upon exposure to incubation temperatures when contaminated.

Growth of *Cl. Sporogenes* in Spiced Ham Media

In this experiment we inoculated spiced ham medium (Jensen *et al*, 1934), the spiced ham containing varying amounts of sodium nitrate, with washed spores of *Cl. sporogenes*. About 50 spores were inoculated into each tube; the tubes were prepared in duplicate. The tubes were then incubated at 99° F. for 21 days and observed each day, the tubes containing the following concentrations of sodium nitrate : 0·02 per cent., 0·05 per cent., 0·10 per cent., 0·20 per cent., 0·50 per cent. and 1·0 per cent.

No apparent growth was observed until after 72 hours, when the control (no nitrate) tubes and the tubes containing 0·02 per cent. nitrate indicated growth by gas bubbles, putrid odour and turbidity. At the end of 76 hours all tubes except the ones containing 0·5 per cent. and 1·0 per cent. sodium nitrate showed active growth. No growth developed in the 0·5 per cent. to 1·0 per cent. tubes after 4 weeks' incubation.

This test indicates that sodium nitrate was capable of inhibiting spore germination or growth in spiced ham media in tubes in concentrations of 0·50 per cent. and above.

Another experiment was performed to determine if heating the spores of *Cl. sporogenes* in the presence of varying amounts of nitrate in the ham media would have some effect on the germination of the spores.

In the first test the tubes containing various amounts of NO_3 were heated to 155° F. for 5 hours after each tube had been inoculated with *circa* 25 spores. A control set of tubes not heated was prepared and all the tubes were incubated 14 days at 99° F. Table II shows the result of this test.

TABLE II.—EFFECT OF HEAT ON SPORES OF " CL. SPOROGENES " IN PRESENCE OF NITRATE SPICED HAM MEDIUM.

Incubation 99° F.	*Growth of Cl. Sporogenes: + = Growth and Putrid Odour. Per Cent. of Sodium Nitrate in Ham Medium.*							
(Days.)	0	·02	·05	·10	·20	·50	1·0	*Treatment.*
4	+	..	..	..	..	..	..	Heated
4	+	..	..	..	..	..	..	Not Heated
6	+	+	..	+	+	..	..	Heated
6	+	+	+	+	+	..	..	Not Heated
10	+	+	+	+	+	..	..	Heated
10	+	+	+	+	+	..	..	Not Heated
14	+	+	+	+	+	+	..	Heated
14	+	+	+	+	+	+	..	Not Heated

There are no indications that spores of *Cl. sporogenes* are injured by heating at 155° F. for 5 hours in the presence of nitrate.

TABLE III.—EFFECT OF HEAT ON SPORES OF " CL. SPOROGENES " IN PRESENCE OF NITRATE SPICED HAM MEDIUM.

Incubation 99° F.	*Growth of Cl. Sporogenes: (+ = Putrid Odour and Turbidity). Per Cent. of Sodium Nitrate in Ham Medium.*							
(Days.)	0	·02	·05	·10	·20	·50	1·0	*Treatment.*
4	+	+	+	+	+	..	..	Heated
4	+	+	+	+	+	..	..	Not Heated
7	+	+	+	+	+	..	..	Heated
7	+	+	+	+	+	..	..	Not Heated
9	+	+	+	+	+	..	..	Heated
9	+	+	+	+	+	+	..	Not Heated
11	+	+	+	+	+	+	..	Heated
11	+	+	+	+	+	+	..	Not Heated
14	+	+	+	+	+	+	..	Heated
14	+	+	+	+	+	+	..	Not Heated

Another experiment was conducted along these lines, all conditions being like the test shown in Table II, except that 1,000 spores were inoculated into each tube. The results of this experiment are shown in Table III.

Here again heating the spores in the presence of nitrate has no specific effect upon growth or germination. The heavy inoculum does, however, succeed in overcoming the effect of nitrate—an observation well in accord with many observations in practice.

The effect of higher temperatures on spores of *Cl. sporogenes* in the presence of nitrate is shown in Table IV. In this test the tubes were heated for 4 hours at 176° F. Each tube was inoculated with *circa* 1,000 spores.

TABLE IV.—EFFECT OF HIGHER TEMPERATURES ON ACTION OF NITRATE ON SPORES OF " CL. SPOROGENES ".

Incubation 99° F.	*Per Cent. of Nitrate in Medium (+ = Growth of Spores).*							
(Days.)	0	·02	·05	·10	·20	·50	1·0	*Treatment.*
4	+	..	..	..	..	..	..	*
5	+	+	+	..	..	..	..	*
6	+	+	+	+	+	..	..	*
8	+	+	+	+	+	..	..	*
10	+	+	+	+	+	..	..	*
14	+	+	+	+	+	..	..	*

* Heated 176° F.—4 hours.

This experiment shows that there may be some heat injury to the spores at higher temperatures in the presence of nitrate. Tables III and IV should be compared.

A test was made with the same materials and inoculation, but the tubes were heated at 200° F. for 4 hours. Table V records the data observed.

TABLE V.—EFFECT OF HEATING SPORES OF " CL. SPOROGENES " AT 200° F. FOR 4 HOURS IN PRESENCE OF SODIUM NITRATE.

Incubation 99° F.	*Per Cent. Sodium. Nitrate in Ham Medium (+ = Growth).*						
(Days.)	0	·02	·05	·10	·20	·50	1·0
2	+	..	..	..	..	..	..
4	+	..	..	..	..	..	..
6	+	+	..	..	..	..	..
8	+	+	..	..	..	..	..
10	+	+	+	..	..	..	..
12	+	+	+	..	..	..	..
14	+	+	+	+	..	..	..

This test shows that higher temperatures than those used in practice in canned chopped ham processing may greatly injure spores of *Cl. sporogenes* when the standard amount of nitrate is present (0·1 per cent.). The *botulinum cook* or *heating schedules* for spores of *Cl. botulinum* (all types) are considered to be :

1·45	minutes for	255° F.
2·78	,, ,,	250° F.
5·27	,, ,,	245° F.
10·00	,, ,,	240° F.
36·00	,, ,,	230° F.
150·00	,, ,,	220° F.
330·00	,, ,,	212° F.

Perhaps in the presence of nitrate and nitrite, and salt as well, the spores of *Cl. botulinum*, as well as its close " relative " *Cl. sporogenes*, are killed at much lower temperatures than called for in standard canning practice. Shelf items of canned meats may be completely sterile even though the " botulinum cook " was not obtained.

The data in Table VI show clearly the well-known effect of magnitude of inoculum. That is to say, the greater the number of spores (or viable cells) in a medium, the greater the difficulty in sterilising the medium. The adjuvant effect of nitrate is clearly shown here. It may be that " where there is an inhibitive influence in a medium it is most strongly exerted toward the more resistant spores which are present " (Cameron, 1940).

Summary

The comparatively obscure history of nitrate as a meat-curing agent is discussed. The literature on the effects of nitrate on bacteria in meat shows unmistakably that nitrate in the cure exerts a definite inhibitory effect upon bacteria. The mechanisms of the inhibitory effect of nitrate on Clostridia are outlined. Adequate plant tests indicate that nitrate in the cure is of benefit in preventing the putrefactive anaerobes from growing in comminuted canned ham and luncheon meats. Nitrites react with

TABLE VI.—"CL SPOROGENES" HEATED IN NITRATE-PORK MEDIA AT 185° F. FROM 1 TO 4 HOURS.

50 Gm. of Meat were placed into each 8" x 1" Tube.
Number of Organisms Inoculated Per Tube:

Group I.—250 organisms (*circa*)
Group II.— 30 organisms (*circa*)
Group III.— 5 organisms (*circa*)

Results after 13 days Incubation at 98° F.

Unheated control tubes all showed growth.

% of Nitrate in Medium.	0			10		
Groups	I	II	III	I	II	III
Heated 1 hr.	+	+	..	..	..	..
Heated 2 hrs.	+	+	..	..	..	..
Heated 3 hrs.	+	..	..	..	..	..
Heated 4 hrs.	+	..	..	..	..	..

% of Nitrate in Medium.	20			50			100		
Groups	I	II	III	I	II	III	I	II	III
Heated 1 hr.	+	..	..	..	..	..	..	..	..
Heated 2 hrs.	..	..	..	..	..	..	..	..	..
Heated 3 hrs.	..	..	..	..	..	..	..	..	..
Heated 4 hrs.	..	..	..	..	..	..	..	..	..

protein when heated and are destroyed, thus leaving the meat in much the same state as fresh-cooked uncured meat. When spores of *Cl. sporogenes* are heated in the presence of permissible amounts of sodium nitrate it is possible that heat injury of spores results, so that a lower temperature may be used than is called for in the classical sterilising schedule. This phenomenon is being investigated by Dr. E. J. Cameron, Director of Research Laboratories, National Canners' Association, Washington, D.C. Both theory and practice of curing meat and canning cured meat teach that nitrate is an invaluable ingredient and, for most cures, should not be omitted.

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Green Vegetables as Protein Foods

(*Continued from page* 156).

and that proportion of them which is digestible at all is only rendered available to the body by courtesy of micro-organisms in the gut. Experiments to assess the biological value of plant proteins, in which vegetables as such are fed, are complicated by large bulk and fermentation, with its accompanying gas formation in the intestine. More satisfactory results are to be obtained by feeding protein fractions prepared from green leaves as raw material.

Although it is important that more work should be done to substantiate the biological excellence of leaf proteins, it seems justifiable to assume that such proteins are of good quality. Rationing at the present time restricts our supply of high quality protein more rigorously than probably any other nutritional factor. A certain amount of justifiable anxiety has recently been expressed, particularly about the effect of protein shortage on growing children. In green vegetables grown in this country there is a potential source of some of the protein we need. On a dry-weight basis turnip tops contain 37·5 per cent. of protein, spinach contains 34 per cent., broccoli leaves 33·7 per cent., brussels sprouts 26 per cent., and cabbage 20 per cent. Assuming that the daily requirement of first-class protein is 35 gm., an 8-oz. portion of boiled spinach provides 32 per cent. of the day's needs. This amount of greenstuff, however, is rather much.

"Meat from Vegetables?"

It should not be beyond the powers of scientific workers to perfect an economically practicable method of extracting protein, not only from vegetables normally eaten, but from herbage in general. No longer only "meat and vegetables"; "meat from vegetables" is also possible.

SYNTHETIC FOOD FATS

A. E. WILLIAMS

UP TO THE present time the production of synthetic fats on a commercial scale for food purposes has not been undertaken in this country. This is chiefly because natural fats have hitherto been available in sufficient quantities, the synthetic products would initially be more costly, and the inherent British aversion to anything pertaining to the artificial in food. Many will remember the almost universal repugnance shown to artificial butter—margarine—when it first appeared on the market, and the widespread disapproval exhibited when hydrogenated whale oil was first used as an edible fat. Gradually—following upon abundant scientific evidence that these fats are at least harmless—this animosity has vanished, and to-day most of us regularly consume, in some form or other, both margarine and hardened whale oil. But we still possess sufficient conservatism to put up our hands in horror at the thought of food from coal, although we all quite agree that in some other well-established branches of chemistry, notably dyestuffs and perfumery manufacture, the synthetic products have practically the same composition and are identical in every way with the natural materials they imitate.

If we, as a nation, prefer to sit back and watch other countries do all the spadework in establishing a synthetic fat industry, it is not the fault of our technicians—who are as eager and competent as those of different nationality—but rather that of those who control the necessary capital to exploit such an innovation. Meanwhile we may all muse upon the number of ships, carrying our fats to us, being sunk by the enemy, and the number of coal-miners—the producers of our potential fat—now unemployed.

Development of Fat Synthesis

The earliest attempt to create a synthetic fat appears to be in the direction of producing fatty acids for soap-making purposes from the relatively costly petroleum products. Thus Schaal (*Jour. Soc. Chem. Ind.*, 1885, **4**, 679) describes a method for producing fatty acids by oxidising paraffin wax in mixture with sodium carbonate. Not much progress was made until the war of 1914-1918. Whatever their justification when shale was one of the principal sources of paraffin wax, they became unsound when the produce of vast oilfields became generally available. Europe has to import petroleum, and to turn any of its fractions into fatty acids is bound to be uneconomic, while in a country like the U.S.A., where petroleum is plentiful, there is no incentive to use such a process, since vegetable fats are at hand in abundance.

Definite progress was made by the Germans during the last war, when they adopted coal products instead of petroleum as their raw material. Some light is thrown on their methods by Franck (*Chem. Zeit.*, 1920, **44**, 309), who describes a process in which about 65 per cent. fatty acids are produced from coal-tar oils resulting from low-temperature carbonisation. Franck made use of oxides of lead and manganese as catalytic agents in oxidising the tar oils with air. When this investigator combined the fatty acids with the alcohol glycol he obtained a material resembling coconut oil. Several other workers have produced similar results, obtaining both liquid fatty oils and also solid fats. Incidentally, fatty acids have been obtained in this country from Scottish shale oil by Francis (*Jour. Chem. Soc.*, 1924, **125**, 381). The cost of all such processes, however, renders them uneconomical in normal times, when natural oils and fats may be freely imported. During the last decade the synthetic production of mono- and di-glycerides, as distinct from the triglycerides which form the bulk of natural fats, has received much attention in Great Britain, and they are used chiefly in medicine, as emulsifying agents in edible products, and also in the textile industries. Within the last few years the Germans have erected large-scale plants for making synthetic fats from water gas, and the cost of such a process is much lower than that of any other method previously used. So low, in fact, as to compete with natural oils and fats in war-time, even in a country like ours, where they may be imported regardless of war conditions, but where, simultaneously, they are subject to greatly increased costs and restricted shipping. This has led to a close study of the problems involved being made in this country, but at present our synthetic food fats from water gas are produced only in the laboratories.

Hydrogenation of Water Gas

Water gas consists of approximately equal volumes of carbon monoxide and hydrogen, being produced by the action of steam on coke. Two main types of products can be obtained by the hydrogenation of water gas (or the reduction of its carbon monoxide by hydrogen), which are (1) hydrocarbon oils, used as motor fuels, and (2) oxygenated compounds, including a number of alcohols and also fatty acids. The type of product produced depends mainly on the catalyst employed. For example, if hydrogen is added to water gas by adding hydrogen to it and the gaseous mixture passed over a heated nickel catalyst, the hydrocarbon methane CH_4 is obtained. Higher members of the series, the liquid and solid paraffins, are obtained by varying the temperature and pressure of operation and the catalyst.

A simple oxygenated compound obtained from water gas is methyl alcohol, and in this case the catalyst used may be zinc oxide. The theory of the latter synthesis has been the subject of controversy, but perhaps the best explanation has been put forward by G. T. Morgan (*Proc. Roy. Soc.*, 1930, A, **127**, 240). In the first stage of the reaction zinc formate is produced, which is next decomposed into zinc carbonate and formaldehyde; the latter then takes up more hydrogen to form methyl alcohol. The paper by Morgan should be consulted for other details.

The production of methyl alcohol in this manner is now a well-established industry in Germany, wherein it is used as a solvent and also in admixture with benzol as motor fuel. Until two or three years ago methyl alcohol was the chief oxygenated product made synthetically from water gas, and its production has been developed to a higher degree than any other oxygenated product of water gas. For example, in making fatty acids from water gas direct an alkalised iron catalyst is used, but the fatty acids form only a proportion of the final products, other constituents being principally alcohols and hydrocarbons. Such a mixture has to be repeatedly distilled and purified to obtain commercially useful products. The alternative method of producing fatty acids from water gas is first to synthesise liquid or solid paraffin hydrocarbons, which can be obtained in high proportion, and then to oxidise these to fatty acids.

Fischer and Tropsch Processes

Prominent among the workers in this sphere are Fischer and Tropsch, and many of the developments are due to these investigators. For instance, they were the first to produce, in 1926, synthetic products from water gas by operating at only atmospheric pressures. In the same year they recorded (*Brennstoffh Chem.*, 1926, **97**, 7) that by using catalysts of the so-called eighth group—*i.e.*, platinum, palladium, etc.—the higher homologues of methane could be produced in high proportion, and that when a cobalt and chromium oxide catalyst was used both liquid and solid hydrocarbons resulted. The catalyst giving the best results was found to be a mixture of metallic platinum with chromium oxide, and by operating at a lower temperature than that at which methane was produced tended to give a higher proportion of hydrocarbons. Accordingly, at a temperature of 430° C. methane is the only product formed, but at 300° C. only 10 per cent. of methane results, with 90 per cent. of higher paraffin hydrocarbons. These hydrocarbons are next oxidised to fatty acids, at temperatures between 140° C. and 160° C., in the presence of oxides of iron, manganese or vanadium. Control of this oxidation process has to be very rigid to avoid over-oxidising the products, which would result in the formation of acids of lower than the required molecular weight. The oxidising reaction normally occupied a period of from 6 to 8 hours, the first hour or so being an induction period during which little

actual oxidation of the hydrocarbons occurs. The taking up of oxygen by the hydrocarbons is an exothermic reaction and proceeds rapidly once the induction period is passed.

So far as published information goes it is not yet possible to produce at will, fatty acids having the same composition as the natural products; and it is usual to partially hydrogenate the synthetic fatty acids in an endeavour to bring them into line with the product desired. This hydrogenation also eliminates undesirable unsaturated compounds of a non-fatty nature, which, if allowed to remain, would render the fatty acids unstable and affect their flavour. As one would expect, solid fatty acids result from the oxidation of solid hydrocarbons, like synthetic paraffin wax, and *vice versa*, although solid fatty acids can also be produced, if necessary, during the hydrogenation of fatty acids from liquid hydrocarbons. Incidentally, the use of ozone has been tried for oxidising the hydrocarbons to fatty acids, but it does not appear to be in general use because it also tends to oxidise the fatty acids themselves.

Esterification of Fatty Acids

The term " esterification " is used to denote the union of fatty acids with glycerine or a similar alcohol so as to form a fat more or less resembling the natural product. In combining the two the glycerine and fatty acids are intimately mixed together and heated to a temperature of 200° C. to 220° C. in the presence of a catalyst, such as one of the sulphonic acids, to accelerate the reaction. The process is generally operated under vacuum, and the water vapour—which is a product of the reaction—is constantly drawn off, through a condenser, by the vacuum pump. The synthetic fats produced in this manner by the German company *Veredlungs Gesellschaft für Oele und Fette*, a branch of the *I.G. Farben-Industrie*, are said to have the characteristics of natural products because the process is so controlled as to produce chiefly tri-glycerides.

To achieve this in practice it is necessary to add a slight excess of fatty acids over the theoretical amount, and this excess results in the synthesised fat having a free fatty acidity of from 3·0 to 5·0 per cent., which, incidentally, is about the average acidity found in a crude edible natural fat in this country. If an excess of glycerine be added, in place of an excess of fatty acids a large proportion of relatively worthless acid esters are formed.

It is doubtful whether these synthetic oils and fats are identical in glyceride structure with the natural products, because the structure of the synthetic material, obtained by the esterification of fatty acids with glycerine, is influenced by the operating temperature, degree of vacuum, and the purity of the reacting materials. However, from a physiological point of view, and as far as nutriment is concerned, this change in the glyceride structure is immaterial.

Cost of Synthetic Lard

An insight into the cost of a synthetic lard may be gleaned from figures furnished by the above German company before the present war commenced.

MANUFACTURING COSTS FOR ONE TON OF 2,240 LBS.

		s.	d.
Heating : 77 lbs. naphtha at 0·75d. ...	=	4	10
Power : 12 kilowatts at 0·5d.	=	0	6
Wages : 5 hours at 1s. 6d.	=	7	6
Maintenance, depreciation, interest ...	=	5	0
		17	10

COST OF MATERIALS

2,130 lbs. fatty acids; 270 lbs. glycerine (100 per cent.)=one ton of synthetic lard of from 3·0 to 5·0 per cent. free fatty acids.		
2,130 lbs. fatty acids at 3·3d. per lb.	=	585·75s.
270 lbs. glycerine at 4·1d. per lb.	=	92·25s.
2,400 lbs.=total material, costing ...		678·00s.
Cost of refining one ton synthetic lard=		25s.
Cost of raw materials	=	678s.
Manufacturing costs	=	17s. 10d.
Gross cost of one ton synthetic lard	=	720s. 10d.

YIELD OF THE PROCESS

Yield of synthetic lard	=	2,040 lbs.
Yield of " acid oil " and oil recovered from spent bleaching earth, which oil is passed back to crude	=	160 lbs.
Total yield	=	2,200 lbs.
Weight of original material ...	=	2,400 lbs.
Irrecoverable oil—loss	=	200 lbs.
Gross cost of one ton of synthetic lard	=	720s. 10d.
Oil recovered=160 lbs., worth		40s.
2,040 lbs. synthetic lard costs		680s. 10d.

Therefore one ton of synthetic lard costs approximately £37 7s. 6d.

The above figures for costs take no account of the cost of the catalyst used, or running the lard over chilled rollers and packing; nor is the cost of converting the refinery soapstock into acid oil, or the expense of recovering the oil from the bleaching earth, considered in these estimates. But these costs are well known in this country, and when added to the German figures the cost of the fully manufactured and packed synthetic lard is still under £40 a ton, which compares favourably with the war-time figure for lard in Great Britain.

S. Meno (*J. Soc. Chem. Indust. Japan*, 1935, **38**, 237B) has recorded two methods of semi-synthetic production of edible fats from inedible materials by means of esterification of fatty acids with glycerine. Lower fatty acids such as propionic acid, or coconut oil fatty acids mixed with hardened fish oil, were esterified with glycerine in the presence of a catalyst such as tin, able to induce the formation of hydrogen; ester interchange occurred and butter-like fats were formed. He also described a method of producing a tallow-like glyceride from " foots " formed in the refining of fatty oils.

The Glycerine Problem

In normal times glycerine is obtained mainly as a by-product in soap manufacture and from fat-splitting processes; but in war-time the bulk of such glycerine has to be diverted to other purposes, thus leaving none for synthetic lard-making. This has led to other potential sources of glycerine being exploited, and the Germans have met with considerable success in this direction. The gas propylene, for example, can be synthesised by hydrogenating water gas at a specific temperature and with a suitable catalyst. The propylene is then subjected to a chlorination process to give trichloropropane, which is converted to glycerine by treatment with a caustic alkali. So that from water gas the two main components of a fat—fatty acids and glycerine—may be derived. However, more attention appears to have been directed towards making glycerine from glucose, of which Germany has a potential abundance in her potato crops. A commercial method for accomplishing this was expounded by Connstein and Lüdecke (*Woch. für Brauerei*, 10, **5**, 1919). In the process described by them glycerine is obtained in good proportion as a by-product during the fermentation of glucose solution with yeast, in the presence of sodium sulphite. Brewer's yeast is added to a 10 per cent. glucose solution at a temperature of 30° C., then sodium sulphite solution run in until the proportion of solid sulphite is nearly one-half that of the actual sugar content. The progress of fermentation is retarded by the sulphite and requires about 3 days to complete. To the fermented material lime and calcium chloride are added to eliminate the sulphite and carbonate, which latter has been produced through the carbon dioxide formed during fermentation. The mixture is next treated with activated carbon to take up certain undesirable by-products, and filtered. Alcohol is recovered from the filtrate by distillation in the usual way, the portion remaining in the still representing weak glycerine, which latter is concentrated and refined by the customary methods. About 25 per cent. of glycerine, based on the sugar used, is obtainable by this method, in addition to a similar amount of alcohol of 98 per cent. strength and about 10 per cent. of acetaldehyde, so that the process is by no means unprofitable.

Glycerine Substitutes

Various materials may be substituted for glycerine in making up a synthetic fat from fatty acids, although these compounds would not approach so closely to the natural products as

would a compound of fatty acids and glycerine. Such alternatives to glycerine include polyhydric alcohols, such as glycol, mannitol, etc. Glycol is an alcohol having properties in many ways similar to glycerine. It may be manufactured by reacting ethylene bromide with potassium carbonate, but a newer and cheaper way is to prepare it from hydrocarbon gases; thus it may be a derivative of water gas. Chlorohydrins are made from the synthetic gases, and these, when hydrolysed, yield glycol. According to Lecoq (*Compt. Rend.*, 1935, **200**, 1979), the esters formed by combining glycol with fatty acids are inferior to natural fats, from the nutritional point of view, and may have toxic properties. Their use in this country has so far been confined to non-edible uses. Mannitol is a hexahydric alcohol originally derived from manna, and occurs in appreciable amounts in some seaweeds; in most other sources it is present in only small proportions. The use of mannitol in synthetic fats would not be a practical proposition unless the supply difficulty can be overcome.

Biological Syntheses of Glycerides

It is worth remembering that mannitol, like glycerine, is a normal by-product of vinous fermentation; the amount of mannitol rises relatively considerably in some fermentations that take a wrong course and produce atypical wines. If mannitol were required in quantity it would be worth while to investigate the possibilities of producing it from sugar by fermentation, just as glycerine has been produced. The possibilities of biological synthesis are even yet not sufficiently widely realised. J. Ramsbottom, in the presidential address before the Botanical Section of the British Association in Blackpool (1936), said: "Modern man does not remain satisfied with the methods of his ancestors or even with those of his immediate predecessors. It is not only that he desires to make two blades of grass grow where one grew before, but he wants them twice as big at half the cost and twice the speed. He had been going to the ant and considering the lilies for many centuries before he realised that moulds and other microscopic fungi were bringing about changes that he was unable to repeat without their aid."

The discovery of vitamin D led to the finding of ergosterol in yeasts. It is now known that most moulds are able to synthesise not only sterols, but fats. An investigation of fat-production by sixty-one *Aspergilli* and *Penicillia* showed that in ten of them more than 15 per cent. of ether-soluble material was formed; and since these species of moulds were not specially selected for fat-building ability, the result may presumably be taken as representative. One of the species of *Penicillia* yielded over 40 per cent. of fat.

Practical Applications

During the last great war the Russians turned their attention to yeasts, with the object of supplementing deficient foodstuffs. P. Lindner suggested using special yeasts for the production of fat. Such a yeast is *Endomyces vernalis*, which does not produce alcohol. It grows on sugars, forming at first a growth which is rich in protein but contains little fat; later the fat content increases, and will reach 15 to 20 per cent. of the dry weight in a fortnight or less. The fat is a yellowish liquid containing triolein and some free fatty acids, thus resembling an inferior olive oil.

It is not uncommon to find fat globules in microscopic growths from sewers. In 1926 Chaston Chapman found a species of *Oidium* blocking up a sewer. On cultivation in nutrient solution this micro-organism formed a film which contained 50 per cent. of crude protein and 10 per cent. of fat. Not only did it thus suggest that it was a concentrated food, but it had the flavour and odour of cream cheese. As the nutrient solution was substantially composed of a carbohydrate and ammonium salts with small amounts of other inorganic substances, the possibilities of such a fungus need only to be mentioned to be grasped. Large-scale cultivation should offer no difficulty in view of the experience already obtained with the microbiological production of citric acid, for which compact cabinets of trays of nutrient solution offering several acres of surface are in commercial use.

Other Methods

A number of methods for the chemical synthesis of pure and technical glycerides are given by F. A. Norris (*Oil and Soap*, 1940, **17**, pp. 257-262), who also discusses a number of applications of such synthesised products, and supplies 146 references to the literature. A recent book is *Gewinnung der höheren Fettsäure durch Oxydation der Kohlenwasserstoffe*, by F. Wittka (1940: Berlin), pp. 167.

LOW TEMPERATURE RESEARCH

THE thirty-first annual May Lecture of the Institute of Metals was delivered on May 28, 1941, in the Clarendon Laboratory, Oxford, by Dr. F. Simon, F.R.S. (Reader in Thermo-Dynamics in the University of Oxford), on "The Significance of Low-Temperature Research". In the chair was the President of the Institute of Metals, Lieut.-Colonel the Hon. R. M. Preston, D.S.O.

The lecturer began by discussing how it comes about that temperature can influence properties of matter, and showed that at low temperatures one must expect phenomena connected with small energy changes. In pre-quantum theory times no such changes could be expected, and consequently the interest in lower temperatures was mostly restricted merely to a race downwards. This changed on the advent of quantum theory, which showed that the vibrational quanta in condensed matter correspond to this region of temperature. The consequent drop of the specific heat towards 0° K. is of profound influence on all properties of matter, particularly through its connection with the third law of thermo-dynamics. This law and its implications for theory and problems of technology were then discussed, along with its corollary, the unattainability of absolute zero.

It was then shown how every phenomenon occurring in any particular temperature region can be used to reach this very region. Consequently the discovery of magnetic states of matter with very small energy differences between them led to a new method for reaching still lower temperatures than had been possible with gas liquefaction—to Debye-Giauque's magnetic method, in fact. The type of information to be expected from investigations in this temperature region was discussed, and similarly for the still lower region which might be reached using the nuclear paramagnetism. There is a type of phenomenon characteristic of the lowest temperatures which can occur only there—viz., that where the zero-point energy is predominant—and in this connection the behaviour of liquid helium was mentioned. Finally, it appears that the low-temperature region can be used to obtain results of great practical interest from model experiments; it is possible in this way to investigate phenomena inaccessible to direct experiments at high temperatures because the requirements involved—*e.g.*, pressure or magnetic field—are then prohibitive.

The Elaboration of Cattle for Canned Meats and By-products

(*Continued from page* 155)

methemoglobin appears to be such that there exists no optimum pressure for the reaction, the rate being proportional to the oxygen pressure. In this it differs from the natural pigment hæmoglobin, for whose oxidation has been found a definite optimum pressure owing to the simultaneous formation of oxyhæmoglobin, which is incapable of oxidation. Undoubtedly nitric oxide hæmoglobin must first dissociate before oxidation, since hæmoglobin in combination with oxygen and carbon monoxide appears incapable of oxidation.

Factors Governing Oxidation

The *p*H and temperature are factors in the oxidation. The *p*H of meat is very close to 6 and is difficult of alteration. The high-temperature-coefficient of the oxidation reaction points to the definite need for refrigeration to preserve the colour of any surface exposed to air—for instance, sliced bacon. Brown discolorations observed on sliced cured meats, which have been frequently ascribed to bacterial action resulting from improper refrigeration, can easily be accounted for in the high-temperature coefficient of the oxidation reaction.

Urbain and Greenwood (*loc. cit.*) describe a new technique whereby the oxygen capacity of hæmoglobin diluted with distilled water can be determined by a slight modification of the Van Slyke-Neill method, and in a final paper by Greenwood, Lewis, Urbain and Jensen the *rôle* of sugars in the colouring of cured meats is discussed. The authors conclude that dextrose, levulose, mannose, galactose, zylose, sucrose, maltose and lactose produced significant changes in the colour and other characteristics of the blood pigments, oxyhæmoglobin and nitric oxide hæmoglobin, in the presence of micro-organisms. The colour changes of the pigments could be correlated with the growth of micro-organisms which utilise the sugars, yielding acid products, and which also aid in establishing reducing conditions. Sugars appear to exert no action on the blood pigments in the absence of micro-organisms or substances produced by them.

(*To be continued*)

THE BREADMAKING INDUSTRY IN WAR-TIME

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THE production of bread in war-time, like so many other phases of modern life, goes on continuously and without apparent interruption. So it must seem to the general public, for bread is always available in sufficient quantity, and ever since air raids were intensified on our industrial areas bread supplies have been maintained at all times and under the most difficult of conditions. In some few cases there have been delays where severe damage has been inflicted during a single night, but even in places where severe damage has occurred to local bakeries, by the midday following bread supplies have been forthcoming in adequate quantities to keep everyone from being hungry.

How has all this been accomplished? may be asked. By elaborate, well-thought-out planning and the goodwill and loyalty of those engaged in the baking industry. The keynote of the organisation has been flexibility and adaptability, and without a host of paid officials the scheme has worked well. Voluntary help and co-operation between all those engaged in producing and distributing the bread has been entirely responsible for the maintenance of supplies.

Mutual Assistance Pacts

First of all, mutual assistance pacts were evolved so that bakers in their own districts undertook to help any of their fellow-traders who might be bombed out. This was soon seen likely to prove inadequate, and so districts were organised and from this regions covering the whole country. Area bread officers and assistants were appointed, all these giving their services voluntarily, and being actively engaged in the baking industry or its organisation in their own particular area, and finally the country was zoned so that supplies of bread could be sent over distances up to 100 miles to ensure adequate supplies in towns where extensive damage was incurred. This has had to be done on several occasions.

All the areas are controlled by a chief bread officer at the Ministry of Food—again a person loaned by the industry to the nation. In this way it will be realised how the baking industry is playing its full part not only in ensuring the continuance of bread supplies, but is further giving generously of its services on behalf of the national cause. These facts are not generally known, but they should be known and remembered not only at the present time but in days to come. The Minister of Food paid tribute to the work of the baking industry in the House of Lords in December last, not only for this side of their work but for assisting him in preventing any rise in bread prices until a Government Costing Committee had finished its work. The baking industry showed great patience in this matter, and due appreciation was paid. Later the bread subsidy was introduced to assist the bakers in meeting the increased production costs which had to be met as a result of war conditions.

Flour

Flour has been controlled since the outbreak of war and one grade, national straight run, has been marketed. For the past eighteen months the quality of the flour has been very good and has exceeded the average for many years. Despite the fact that none of the super grades of flour have been available, the quality of the flour has been reflected in the quality of the bread available all over the country. This has largely been due to the use of higher proportions of Manitoban wheats in the grists during this period. Adequate supplies have always been available, and the bakers have assisted the Government in carrying part of the security stocks which have been built up. Many bakers were unable to help in this matter owing to a shortage of storage accommodation, but in the majority of bakeries the maximum stocks have been carried. The extraction has recently been raised to 75 per cent., and it is now suggested that this should be further increased to 78 per cent.

Yeast

Yeast supplies have been adequate at all times, although the yeast manufacturers were called upon to supply extra quantities after May of last year, when all supplies previously obtained from Denmark, Holland, Belgium and France were no longer available. Fortunately the yeast-producing capacity of this country was adequate to meet such a contingency.

Large stocks of yeast have been carried in cold store, and during the winter bakers have been carrying two or three days' supplies as well. Such a dispersal of stocks has enabled many difficulties to be successfully overcome. The problem of distribution has not been easy, but it has been surprising how regularly the deliveries have been maintained, particularly after severe bombing.

With such a dispersal and storage of yeast there have been noticeable variations in the quality of the yeast, but few sufficiently great to render breadmaking more than a little difficult. Storage of yeast for unduly long periods has never been considered the ideal practice, but it is surprising how well the job has been done, and, although the occasional deterioration has meant that baking procedure has had to be changed, there has always been extra yeast available when it was required, so that modification of procedure based on extra yeast consumption has always been practicable. Some of the variations in yeast, as compared with peace-time standards, have been occasioned by the limitation of supplies of raw materials to the manufacturers themselves.

In the last war yeast supplies were far more closely watched, since there was a shortage at that time of yeast-producing ability. There were no factories in this country producing high-class bakers' yeast, such as exist to-day with their tremendous production capacity, and foreign supplies then had been of paramount importance.

The yeast manufacturers and distributors have control of the problem of distribution and have complete plans set out to meet all emergencies. Up to the present time none of the most extreme ones have had to be used.

This, like the bakers' effort, is another example of a voluntary contribution to the war effort.

Recently supplies have been curtailed, but this has been considered a temporary measure only.

The Ministry of Food issued advice to bakers in September last in the form of a memorandum on how to work if yeast supplies failed. Since that time other schemes have been worked out, so that, assuming a complete failure of yeast production, breadmaking could still be carried on satisfactorily, since every baker has been advised as to how he can be his own yeast manufacturer in an emergency. A simple and straightforward procedure has been laid down which, if followed, will ensure adequate bread production. Further, the question of the utilisation of dried yeast, the old sour-dough process, and even brewers' yeast, is discussed. Brewers' yeast, however, is not likely to prove satisfactory alone, since it is very poor in gas-producing power. It could, however, be used in conjunction with bakers' yeast when this is in short supply.

Bread

The Bread Order of last year restricts the number of shapes of bread a baker may produce, and for the period of the war supersedes the Sales of Food (Weights and Measures) Act, 1926. Vienna bread must be of 8 oz. weight, and all other types of 1 lb. or integral lbs.

No hardship has been inflicted by this order; on the other hand, benefits have been derived, since some labour is saved by the limitation of shapes. This was the main objective of the order.

No action has been taken regarding the composition of bread. As with confectionery, freedom of action has been allowed to the baker with the exception of the addition of milk or milk powder in April of this year. Those bakers who formerly added fat have had to reduce the amount added, owing to the rationing of fats, whilst some have voluntarily omitted it from their formulæ. Other improvers and malt are still being widely used, and with yeast variations are found most useful in maintaining regular bread production.

By the time this article appears bread will be on sale in certain areas made from the Government fortified flour, containing both the Vitamin B_1 and calcium addition. The experimental work which has been carried out prior to the introduction of this flour has been most comprehensive, and it is not anticipated

that any practical difficulties will arise. Great publicity has been given in the press to the question of these additions, and we understand that since the idea was first raised in Parliament last July the Ministry of Food have received letters from people who have already suffered in health, apparently from auto-suggestion. By now most of such premature cases will have fallen into oblivion and a fair trial may be given to the flour.

National Wheatmeal

Although the national wheatmeal has shown no striking increased consumption up to date, time alone will show the development of this and the degree of appreciation accorded to it by the general consumer.

If the bread is well made it possesses all the smooth eating qualities of white bread with just that something different which is indefinable. It does not compete with either white bread or wholemeal; it is something in between and different. Backed by the publicity which is being put out, it will take on by those who are becoming more nutritionally minded and who do not like the normal roughage of wholemeal.

The 85 per cent. meal is essentially a compromise and may yet prove something more. It contains a high mineral content and a low fibre content. It has a high vitamin B_1 content and, moreover, it is considered that the calcium salts are more readily assimilated than in wholemeal because of the lower phytic acid content. Whether this bread will ultimately be reinforced with calcium salts has yet to be decided, but research is being carried on and decisions will ultimately be arrived at.

Delivery of Bread

Delivery of bread has presented more problems than production, due to petrol rationing and the difficulty of obtaining staff. In many places delivery has been reduced to three days a week, and where unanimous action has been taken the results have been most satisfactory. Zoning of wholesale delivery has also effected considerable savings and the elimination of much overlapping which formerly occurred. Rationalisation of delivery has been discussed, but in view of the failure of the milk trade to reach any agreement on this matter, it seems unlikely that any national scheme will be tried out for bread. Regional schemes of mutual arrangements, modified from time to time in the light of changing man-power problems, will most probably meet the case and a universal adoption of a three-day delivery scheme would prove satisfactory in the majority of places. Developments along these lines seem the most probable.

Conclusion

In conclusion it can be said without fear of contradiction that the bread supplies have been maintained in a most regular manner throughout all sorts of conditions, and the quality of the bread itself has been above the average which held in pre-war days. The next twelve months are likely to prove interesting, since they will cover the period when the fortified white flour and national wheatmeal will be the breads of the nation, with possibly longer extraction white flour before long and in the autumn the possibility of potato addition again as in the last war.

THE CONTROL OF TINS AND CANS (No. 4) ORDER, 1941

THIS Order, published on April 28, is of interest to all manufacturers and users of tins and cans. Simultaneously with the Order the British Standards Institution has published a booklet No. 866, Parts I and II. Part I deals with foodstuffs, and Part II with commodities other than foodstuffs.

The new Order No. 4 covers much more ground than that covered by Orders No. 1, 2 and 3, and to the layman is not very easily understandable, and, as it will be closely studied by all users of tinplate, a useful pamphlet has been issued by the Metal Box Company, Ltd., which elucidates some of the clauses in the Order.

The explanatory notes* are as follows:

1. The Order replaces all the three previous Orders, which are automatically cancelled.

2. It came into force on April 28, 1941.

3. The materials which the Order governs are plates and sheets of all kinds—*i.e.*, tinplate, blackplate, etc.—whether unfabricated, printed or partly fabricated. Sect. 10 (1).

4. It is important to note the inclusion in the Order of partly fabricated and printed plate, which will be referred to again later.

5. Two new British Standards Institution Schedules (yellow books, Nos. 866, I and II, 1941, No. I for food products and No. II for other products) accompany the Order and are referred to in it as the British Standard Schedules. These Schedules replace the previous booklets issued with the No. I Order.

6. At the end of the Order itself appear two schedules referred to as the First and Second Schedules, which give a list of articles and commodities for which tinplate is completely prohibited. Sect. 1 and 2.

7. Articles and commodities which are not mentioned either in the schedules of the Order or in the B.S.I. tables are not restricted by the Order.

8. The provisions of the Order do not apply to—

(i) Test sample tins (marked as such). Sect. 8 (*a*).
(ii) Articles for export. Sect. 8 (*b*).
(iii) Articles for use by Government Departments on either direct or indirect contracts. Sect. 9 (1) (*a*).
(iv) *For a period of three months only*, ending July 25, 1941, to containers which were printed or partly fabricated on the date of the Order. Sect. 9 (1) (*b*).

9. This last provision is a new one and means that any printed or partly made containers or articles which are not now permitted by the Order must be completely finished within three months after the date of the Order, otherwise they cannot be made up and the material must be used for other purposes.

* *This explanation is not an official document, but is issued by the Metal Box Co., Ltd., for the convenience of tinplate users.*

10. The use of containers which are larger than the largest in the appropriate table is allowed if they are of a type already in common use. Sect. 10 (1) (*a*) and (*b*).

11. Various definitions are given of what is meant by "controlled material", a "returnable container", a "crown cork", etc. Sect. 10.

12. A fabricator is allowed to manufacture only such tinplate containers for those commodities mentioned in the B.S.I. Schedules as are of the sizes and types set out therein.

13. The packing of any one of the prohibited items (except in containers which were completely or partly made before the Order, and in addition are not mentioned in the B.S.I. Schedules) is not allowed. Sect. 4 (*a*).

14. A packer making first use of a permitted container must pack it with the net weight or capacity and/or with the ullage specified in the B.S.I. Schedules. Sect. 4 (*b*) and (*d*).

15. A packer cannot use a returnable container for a purpose not allowed by the tables whilst it is still serviceable for one which is allowed. Nor can he use it for another purpose after it has become non-serviceable for the original purpose, except by packing it to the fullest possible extent. Sect. 4 (*c*) (i) and (ii).

The whole of Section 4 puts responsibility on the packer which was previously only laid on the fabricator.

16. The same weight of one brand of tobacco may not be packed in more than one size and type of container (except in existing containers), nor may printers' ink pastes be distributed in a greater number of containers than the maximum shown in the B.S.I. Schedules. Sect. 6.

17. Crown corks must either be plain or, if printed, be of a solid colour, with the exception of certain crown corks for special milk bottles.

18. The acts of any carrier or warehouseman, etc., employed by a company will, of course, be considered as the acts of the company itself. Sect. 9 (2).

19. Attention is drawn to the instructions in the B.S.I. Schedules for reading the tables, which now contain, in addition to the previous instructions, further paragraphs dealing with ullage and tolerance in the measurements.

20. The Order made by the Minister of Supply is issued under the Defence of the Realm Regulations and the penalties for infringement are three months' imprisonment or £100 fine, or both, on each count.

ERRATUM

IN the article on "Poppy Seed Oil", FOOD MANUFACTURE, page 115, Dr. R. Melville's name was printed erroneously in three places as "Dr. Miller".

NEWS FROM THE INDUSTRY

Organisation of the Ministry of Food

The Minister of Food has recently decided to make certain changes in the organisation of the Ministry, directed to placing more definite responsibility on the head of commodity division.

Mr. J. F. Bodinnar, the Commercial Secretary to the Ministry, has become the head of the Supply Department, which comprises all the commodity divisions. He will be assisted by five senior administrative officers, who will be chiefly concerned with questions of policy and with matters affecting other Government departments — *e.g.*, the Treasury.

No alteration has been made in the existing arrangements in the Meat and Livestock Division, the Cereals Division and the division which deals with fruit, vegetables and potatoes.

In the remaining commodity divisions responsibility has been placed upon the following directors:

Sir Bryce Burt, Director of Animal Feeding-Stuffs.
J. Loudon, Director of Bacon and Ham.
H. E. Davis, Director of Butter and Cheese.
F. Wilkinson, Director of Canned Fish.
John Cadbury, Director of Cocoa.
A. E. Gough, Director of Dried Fruits.
J. A. Peacock, Director of Eggs.
John Adamson, Director-Designate of Fish.
Herbert Davis, Director of Oils and Fats.
H. L. Sanderson, Director of Rice.
Colonel F. C. C. Balfour, Director of Starch.
W. J. Rook, Director of Sugar.
Sir Hubert Carr, Director of Tea.

* * *

Manufacture and Use of Vitamin A

The Minister of Food has made an Order which came into force on June 23, 1941, prohibiting, except under licence, the manufacture or use of vitamin A.

The Order does not apply to the manufacture or use of vitamin A for medicinal, pharmaceutical or scientific purposes.

Applications for licences should be made to the Ministry of Food, Oils and Fats Division, Pwllycrochan Hotel, Colwyn Bay, Denbighshire.

* * *

Marking of Imported Bacon

The Minister of Food has made an Order, which permits the importation and sale of bacon and ham in the United Kingdom free of the obligations imposed by the Merchandise Marks (Imported Goods) No. 3 Order, 1934, or by any other Order in Council under Section 2 of the Merchandise Marks Act, 1926, which provides that such goods must bear an indication of their origin.

The Order, which has been made under the Defence (General) Regulations, 1939, as amended, came into force on June 14, 1941, before the arrival of shipments of bacon and ham from the U.S.A.

Food Prosecutions

The Ministry of Food announce that from the beginning of the war until the end of March they have undertaken 15,972 prosecutions under the Food Control Orders. Of these prosecutions 15,120 have been successful.

* * *

National Wholemeal

At the request of the Ministry of Food, the Board of Education have asked school canteens to use national wheatmeal bread and flour and to discontinue the use of white bread as soon as possible.

* * *

Control of Import of Canned Fish

From July 1, 1941, the Ministry of Food becomes the sole importer of canned fish. The Ministry does not, however, propose to requisition stocks or the imported canned fish which has arrived in the United Kingdom before that date.

Control of distribution, including the distribution of home-produced canned fish, will be effected as soon as practicable after July 1.

* * *

Manufacture and Prices of Home Produced Canned Meat Products

The Ministry of Food announces that an Order has been made to control the manufacture and prices of home-produced canned meat products. From July 7, 1941, the manufacture of meat products in airtight tins and glasses will be limited to meat and fish pastes, meat and vegetable soups, meat roll or galantine, and ready or preserved meals packed in prescribed sizes of containers. Meat extracts are not affected by the Order.

Minimum standards of quality are laid down for soups based on solid, protein and fat content. Meat and fish pastes are required to contain not less than 40 per cent. and not more than 60 per cent. meat or fish, and the meat content of meat roll or galantine and ready or prepared meals must be not less than 30 per cent. and not more than 45 per cent.

The containers of the specified meat products are required to be labelled giving particulars of the description of the product, the name and address of the manufacturer, and a statement that the product complies with the statutory requirements of the Minister of Food.

From July 7, 1941, no person may sell by wholesale any canned meat product which does not comply with the requirements of the Order, and from August 4, 1941, sales by retail will be similarly limited to the specified meat products complying with the Order.

The Order sets out the maximum wholesale and retail prices which may be charged on sales of these specified meat products. These maximum prices become operative on July 7, 1941, but a retailer is allowed until August 4, 1941, to dispose of stocks not canned in accordance with the requirements of the Order.

More Whey, More Pigs

As much summer milk as possible will be converted this year into products that can be stored for winter use. Cheese-making on a greater scale will therefore be undertaken, and the resulting whey will be preserved for human consumption or calf food. A scheme that involves, in some instances, increased allowances of cereal feeding-stuffs has been approved to help the economic disposal of whey.

1. Instead of the ordinary rations for their pigs, creameries and cheese factories will receive 28 lb. of cereal feeding-stuffs per month for each pig kept by them in June, 1939, unless, since that date, whey drying facilities have become available. This should suffice to keep one-sixth more pigs during the cheese-making season than in June, 1939.

2. Farm cheese-makers unable to process their whey or to dispose of it for processing will be allowed feeding-stuffs on the same terms. If they did not keep pigs in June, 1939, they will be allowed 24 lb. per month for each pig being kept to consume whey.

3. Creameries and cheese factories with a surplus of whey that cannot be processed or consumed by their pigs will offer to supply any pig-keeper willing to purchase the surplus whey at a price not exceeding ¾d. per gallon at the creamery.

4. If the creameries or factories still have a surplus after farmers' requirements have been ascertained, they will be allowed 24 lb. of cereal feeding-stuffs for each pig they keep in addition to those provided for under (1) above.

Applications for the ration coupons should be made monthly to county war agricultural executive committees.

* * *

Food for Fire-Watchers

Arrangements have been made for the issue of rationed food for the use of fire-watchers, etc., engaged in duties connected with the Fire Prevention (Business Premises) Order, 1941.

So far as possible the personnel concerned should obtain meals from existing canteens or other catering establishment, but consideration may be given to the registration of new canteens provided that the number of persons involved justifies a catering registration. It will not be possible, unless circumstances are very exceptional, to grant catering registration unless it is proposed to provide hot meals daily to at least twenty persons on duty in connection with fire-watching, etc. For small parties arrangements will often be possible for meals to be taken with another small party at adjoining premises. In other cases the fire-fighting personnel should bring their own food; their employers will be able to obtain for them permits for additional tea on application to the local food office.

These arrangements apply only to business premises. No special facilities can be granted in connection with the service of meals to fire-watchers on private premises.

Assistance for Food Traders in Transport Difficulties

Some food traders do not sufficiently appreciate that when they get into difficulties with their transport they can always consult the nearest divisional food office. In every division there is an assistant divisional food officer for transport, with a number of assistants, whose business it is, in conjunction with the port food movement officers and the Food Movement Control Section at headquarters, to make arrangements for the rapid and efficient movement and storage of foodstuffs of all kinds, whether owned privately or by the Ministry. These officers are in constant touch with one another, with the ports and with headquarters, and are kept fully informed of the transport situation by road, rail and inland waterway within their division and in other divisions with which they are likely to be concerned.

They are also responsible for seeing that food traders get adequate supplies of petrol and for taking up with the Ministry of War Transport questions of spare parts for motor vehicles and the replacement of worn-out vehicles.

Recently cases have occurred where complaints from food traders of difficulty in meeting their transport needs have been sent to headquarters and on investigation it has been found that these traders never approached the transport officer at their divisional food office, and therefore did not have the benefit of the help which is readily available.

* * *

Uniting Science with Practice

An important step in bringing the fruits of agricultural research into the hands of the ordinary farmer was recently announced in the House of Commons by Mr. R. S. Hudson, Minister of Agriculture, who stated that he had appointed an "Agricultural Improvement Council for England and Wales" to devise methods for seeing that promising results of research are brought as rapidly as possible into ordinary farming practice.

The Council will advise from time to time on agricultural problems that seem to need scientific investigation. It will consist of a chairman and twelve members, appointed for three years with the possibility of reappointment. It includes practical farmers as well as distinguished scientists. For the main purpose of this new body is not so much to gain fresh knowledge as to see that the men on Britain's 375,000 farms hear of the research that is useful to them, understand it, and apply it.

* * *

Novel Cold-Storage House

A cold-storage house built of ice, and erected near Moscow in the winter of 1939-1940, has proved to be a convenient and cheap storage plant, according to the Obruchev Institute for the Study of Permanently Frozen Subsoils.

The ice-house was built in the following manner: A light frame structure was put up, the walls and ceilings of which were watered gradually until solid ice was formed. This coat of ice was covered with peat, shavings and sawdust, thus forming an insulating layer which, in its turn, was moistened and also frozen. The layer turned out to be excellent for preventing the ice from thawing in the summer. The floor of the house was also of ice.

In the winter, during severe frosts a supply of cold air was stored up inside the ice-house by ventilating and freezing. For the rest of the year the air within the ice-house remained at a more or less constant temperature, between −1° C. and 1·5° C.

* * *

New Bread

Scottish bakers want a Government Order forbidding the sale of new bread to the public. A twelve-hours-old bread rule would, they hold, conserve the nation's food supply, would conserve the health of the people, and, finally, would mean that bakers need not start till 6 a.m and so avoid working during air raids.

A resolution to that effect was put by the Falkirk branch of the Scottish Union of Bakers, Confectionery and Bakery Workers at the fifty-fourth annual delegate meeting at Girvan, held on June 10 to 12. Glasgow, Edinburgh, Greenock, Paisley and Dunfermline branches all support this move against night baking.

* * *

The Surplus Fruit Preserving Scheme

In view of some misconceptions that still exist regarding the plans made for preserving surplus garden fruit in England and Wales, the Ministry of Food wishes to make the following points clear:

1. The preserving centres are being organised in urban areas by the food control committees and in rural areas by the Women's Institutes. Some twenty other women's organisations, such as the Co-operative Women's Guilds and the Townswomen's Guilds, have also been invited to assist.

2. In both rural and urban areas it is open to anyone, whether or not she belongs to the Women's Institute or to any other organisation, to offer to help in the work of the preserving centre.

3. There is no compulsion on private fruit-growers to send their fruit to the preserving centres. They are, indeed, encouraged to consume, preserve, sell or give away as much of their own fruit as they wish. It is not, however, possible to allot sugar to individuals for preserving, and, to avoid any waste of fruit, all private growers are asked, as a national service, to sell to the preserving centres any fruit they cannot dispose of in these ways.

4. Before the introduction of the Preserves Rationing Scheme it was intended that those bringing fruit to the preserving centres should be able to buy back a limited quantity of the jam produced. Now that jam is rationed this would clearly be unfair to those who grow no fruit. All jam and canned fruit made at the centres will accordingly be sold to the trade, and the jam will be distributed under the Preserves Rationing Scheme.

Straw Wanted for Paper

Paper mills want some 250,000 to 300,000 tons of cereal straw a year. Wheat straw is especially suitable.

A scale of prices was agreed some little time ago between the National Farmers' Unions of England and Scotland and the Papermakers' Straw Trading Company that buys on behalf of all the mills concerned. The price guaranteed by the Company to farmers in England and Wales is 65s. per ton in the Eastern Counties and 70s. elsewhere. Several thousand tons are required weekly between now and next harvest.

The ploughing campaign has increased the production of straw, and will increase it further next harvest. Even allowing for its wider use as a feeding-stuff and the increased importance of any adequate supply of farmyard manure, there will be a surplus on some farms of wheat and barley straw now that the grass is on the way.

Farmers will not only be serving a national interest by helping to keep up paper supplies from home resources. They will be developing a market that they will find remunerative during the war, and very possibly afterwards, when the shortage of shipping and other factors will drive us to rely more upon home materials than before the war.

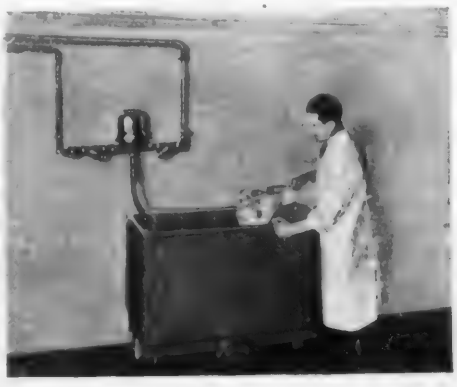
Those willing to sell straw should get into touch with the Papermakers' Straw Trading Company, Ltd., 16, Eastcheap, London, E.C. 3, or at 10, Atholl Crescent, Edinburgh.

* * *

Hot Water for Ham Cleaning

For many applications in the food industries it is of great importance to be able to obtain a supply of hot water, maintained continuously and automatically at any desired temperature, by the direct addition of live steam to cold water.

Much interest attaches, therefore, in this connection to the high-duty Leonard-Thermostatic "Type DS" Mixer, having two 1-in. inlet pipes, one for steam and one for cold water, and a 1¼-in. outlet pipe for the blended hot water. A typical application is the cleaning of hams before boning and canning, the object being to remove a slight outer film of fat. For this purpose the hams are contained in mobile rectangular washing tanks, running on wheels, being pushed over the floor. These tanks are filled with very hot water at 180° F., which is supplied from the thermostatic mixer fixed in



any convenient position—say, on a wall—with the inlet steam and cold-water pipes on either side and the hot-water discharge at the bottom, using for this purpose a permanently attached flexible hose.

In one particular installation the cold water is supplied at a head of 4 ft. 6in. and the steam at 10 lb. per sq. in. (reduced from 50 lb. per sq. in.) pressure, but naturally the conditions can be varied as desired. After being cleaned in this way with very hot water the hams are boned, packed in tins, sealed, and cooked in steam ovens.

The thermostatic mixer is a production of Walker, Crosweller and Co.,

* * *

Radiovisor Auto-Fire-Bomb Detector

An equipment employing the light, sensitive selenium cell for detecting and locating incendiary bombs is the Radiovisor Auto-Fire-Bomb Detector made by Mortimer, Gall and Co., Ltd. This apparatus in the reverse form has been used for many years by the London Passenger Transport Board for traffic records, for controlling passenger lift overruns, for protecting the Crown Jewels and many of the valuables which have been exhibited at Burlington House.

The apparatus can be used either inside or outside buildings, and its purpose is to make difficult legislation both effective and efficient, at the same time eliminating the personal hazards.

Detector units are placed either inside or outside the building—or both, depending on the structure of the roof and the principle upon which the fire-watchers and spotters operate. The number of detector units required depends on the number of key positions to be protected. Each detector will cover an uninterrupted area of from 8,000 to 10,000 sq. ft., and is connected to the normal electric light system, and then, via the auxiliary gear, is wired back to the alarm bell and bomb "locator" in the control room. The alarm bell and bomb "locator" can be duplicated if required, so as to ring simultaneously in two different positions.

Immediately bombs fall on the area protected, various detectors will be actuated; they will ring the alarm and will show on the "locator" where the bombs are to be found. Thus informed, the controller can dispose his fire-fighting squad to the best possible advantage. No bombs remain undetected to cause major conflagrations. Also bombs in vulnerable places, such as pattern shops, wood stores, paint sheds, etc., can have more men concentrated on them than those which fall in less vulnerable places, such as loading yards, concrete roofs, etc.

Experience shows that the use of automatic fire-bomb detectors frees the human watchers from the hackwork and unnecessary hazards of shrapnel, leaving them available for their real job of fire prevention.

The selenium cell bomb detector was one of the principal reasons why the Institute of Electrical Engineers have submitted to the Ministry of Home Security a memorandum pointing out the advantages of this form of automatic detection and location, and is also the subject of a British Standard Specification BS/ARP/53.

From Perfumes to Food Products

From being one of the world's foremost perfume and essence distillers, with branches and depôts all over the world, Lautier Fils, Ltd., have, since the outbreak of war, swung over almost 100 per cent. to the manufacture of foodstuffs and extracts, including coffee essences, onion essences, fruit essences, to say nothing of dozens of other essential flavours to fill the gap caused by shortages of vital commodities, such as eggs, butter, cheese and cream.

Founded at Grasse in the year 1795, the company has through its long career gone steadily from strength to strength. Soon after the termination of the Great War in 1918, a London office and depôt superseded their long-established agency in Great Britain and Ireland for the distribution of essential oils, natural and synthetic perfumes, and all raw materials for perfumery.

A factory was later opened at Chiswick, to cope with the vast increase of business in this country and abroad, and this has enabled the firm to attain the enviable position of being able to supply almost everything essential to the various trades for which it is now catering.

As a result of many months' intensive research, some excellent natural food products have been produced, and the factory began to manufacture many substitutes on a very large scale.

Extracts of pure coffee, and rum and coffee extract, are among the products which are now being made to counteract shortages. Unfortunately the demand still exceeds the supply, but the output is being further increased. The summer beverages are well covered by a very large variety of fruit essences for mineral waters and ices, of which large stocks are already in hand.

This is one example of many of those firms who have rallied to the national effort by switching over to the production of war-time necessities, and Lautier Fils, Ltd., may be congratulated on their achievement.

* * *

Distribution of Foodstuffs

The following resolution was passed at a meeting of the Council of the London Chamber of Commerce and transmitted to the Minister of Food:

"The Council of the London Chamber of Commerce strongly deprecates the raising of the price of foodstuffs to the public through the intervention of persons not previously engaged in their distribution. These intermediaries are rendering no service but, on the contrary, are adding a series of profits between the legitimate wholesale distributor and the retailer, and in the process are defeating the efforts of the legitimate trader to ensure a fair distribution of available supplies throughout the country since these intermediaries are solely concerned in selling goods to the highest bidder wherever he may be. In those cases where maximum price orders prescribe a maximum retail price and wholesale intermediaries have already driven the price up above that level, the effect of the order is merely to ensure that stocks are frozen.

"Similarly, the 'Standstill' Order of December 2, which was imposed by the Ministry of Food with the express intention of defeating the activities of the interloper, has merely resulted in the penalising of the legitimate trade and the freezing of stocks.

"The Council of the Chamber accordingly urges the Government to license those concerns only which were engaged pre-war in the distribution of foodstuffs, wholesale and retail."

* * *

Power Pumps

Small triplex single-acting power pumps have been recently developed by Worthington-Simpson Ltd., and can be used for any service where a small quantity of water at high pressure is required. They are ideal for producing a high-velocity jet for washing purposes, and are also suitable for feeding small boilers. They are useful to filter manufacturers, water-purification engineers, and on any service where a definite quantity of fluid at high pressure is to be injected.

The following are the main features of design:

(1) Totally enclosed crankcase, self-oiling, dustproof power end. (2) Crankcase holds a liberal supply of oil, making it unnecessary to renew oil at frequent intervals. (3) Main bearings are of large area, designed to carry full load with little wear and to require no adjustments. (4) The whole of the driving parts in the crankcase can be easily and quickly withdrawn in one assembly for inspection or replacements, by removing the crankcase cover and unbolting the main bearings. (5) Oil leak preventers are fitted where the plungers pass through the crankcase to prevent oil escaping. (6) The plungers are fitted with deflectors midway between the power end and pump end, which absolutely prevent water or oil creeping along the plungers.

* * *

Valves in Food Equipment

A vitreous lining to a valve used in connection with liquids and semi-solids in the foodstuff industry is one that makes for hygienic conditions. From this point of view the Saunders Glass-lined Diaphragm Valve, which is fully described in the *Handbook of the Saunders Valve Co., Ltd.*, is very interesting. The makers stress the following points: (1) The fluid comes into contact only with the vitreous lining of the valve and the special white rubber of the diaphragm; (2) there are no pockets to trap fluid which may give rise to fermentation or bacterial infection. When the valve is open there is a "streamline" flow right through, and the dismantling of the valve for cleansing is an operation taking only a few seconds. When the valve is closed the rubber diaphragm beds down on the glass-lined seat or weir in such a way that even though the fluid may contain solid particles in suspension there can be no leakage. Again, though the valve action is permanently lubricated, there is not the slightest possibility of the lubricant contaminating the fluid handled. The diaphragm acts as a seal, completely isolating the working parts of the valve from the fluid in the pipe-line.

The London Chamber of Commerce (Incorporated)

At the annual meeting of the London Chamber of Commerce Sir Geoffrey R. Clarke, C.S.I., O.B.E., was re-elected President of the Chamber for the ensuing year, having already held this office for one year.

He is also a Past-Chairman and Deputy-Chairman of the Council of the Chamber and is the Chairman of its London Postal and Telecommunications Advisory and National Defences Committees.

The following were re-elected members of the Council:

Donald G. Begg, M.B.E. (sole partner, D. G. Begg and Co., South American merchants); Chairman, Argentine and Uruguayan Section.

W. E. Blackburn, C.B.E. (a director, Vatric, Ltd., electrical and mechanical engineers).

Ashton Davies, C.V.O., O.B.E., J.P. (Vice-President, the London, Midland and Scottish Railway Company.; Deputy-Chairman, Ribble Motor Services, Ltd.; and a director of Blackpool Omnibus Stations, Ltd., and British Holiday Estates, Ltd.).

Sir J. Fortescue Flannery, Bart., D.L., J.P. (a director of Barclays Bank, Ltd., and Chairman of E. W. Tarry and Co., Ltd; Flannery, Baggallay and Johnson, Ltd.; Callender's Cable and Construction Co., Ltd.; Anchor Cable Co., Ltd.; and other companies), Past-Treasurer of the Chamber and Past-Deputy-Chairman of the National Defence Committee.

Alan M. Gillies (partner, Davidson, Unwin and Co., Brazilian merchants).

Lieut.-Colonel G. R. Harding, D.S.O. (Chairman, Maconochie Bros., Ltd., preserved provision manufacturers), Deputy-Chairman of the Council and Past-Treasurer of the Chamber.

P. Nesbitt (Managing Director, Gollin and Co. [Pty.], Ltd., Australian and New Zealand merchants).

Maurice A. Ockenden, M.I.Mech.E. (a director, Duke and Ockenden, Ltd., engineers), a Deputy-Chairman of the Petroleum and Allied Trades Section.

R. C. Burton Rowe (Chairman, Burton Rowe and Viner, Ltd., incorporated insurance brokers).

Sir Edgar Sanders (the director, the Brewers' Society; Chairman, Jos Tin Area [Nigeria], Ltd.; and Lower Bisichi [Nigeria] Tin Mines, Ltd.), Past-Treasurer of the Chamber, Past-Chairman of the West African Section, and Past-Deputy-Chairman of the Patents, Trade Marks and Designs Section.

W. J. Thompson (senior partner, W. J. and H. Thompson, tea, rubber and colonial brokers).

Charles S. Wilson, M.C. (Life Governing Director, Campbell and Phillipps, Ltd., colonial produce commission merchants), Past-Chairman of the London Court of Arbitration.

The following were elected as Honorary Auditors for the ensuing year:

Richard W. Witty, F.S.A.A. (Button, Stevens and Witty, incorporated accountants).

Kenneth A. Layton-Bennett, F.C.A. (senior partner, Layton-Bennett and Co., chartered accountants)

OBITUARY

William Lewis Davies (1896-1941)

When William Lewis Davies died in India on May 15 the world of dairy science lost one of its hardest workers in the prime of his powers. It is a loss we can ill afford, for it was generally recognised that Davies was in a class of his own in dairy analytical chemistry. The writer has never known anyone with the facility in analysis that "W. L." possessed. For him to take samples of a number of cheese in the morning and then come along with a complete nitrogen distribution before lunch was quite a commonplace. The other outstanding characteristic was an extremely wide knowledge of agricultural chemistry, and he was frequently consulted by people in many kinds of industry and in many countries.

His career was a good example of success achieved without influence or family fortune. The son of a Carmarthenshire farmer, he was educated at Llandilo County School, and on the outbreak of the last war joined the Royal Horse Artillery and saw much active service in France. After demobilisation he proceeded to University College, Aberstwyth, where he graduated B.Sc. with first-class honours in chemistry. He later entered Gonville and Caius College, Cambridge, where he graduated Ph.D. In 1925 he was appointed Advisory Agricultural Chemist at Reading University, and soon afterwards in 1927 Biochemist at the National Institute for Research in Dairying, where he soon established himself as a leading researcher. His early work had been mainly on the constitution of the proteins. At Shinfield he tackled many of the pressing problems in dairy chemistry and published numerous papers on fishiness in butter, deterioration in oils and fats (especially incipient rancidity), the effect of sunlight and metals on milk, the proteins and chlorine in milk, the metabolism of betaine, wrapping materials for foods, and on cheese ripening. In 1935 the University of Wales conferred its D.Sc. on him, and in 1936 he published the first edition of his *Chemistry of Milk* and firmly established himself as a leading authority on the subject. Up to the end of 1938 he was a constant contributor to FOOD MANUFACTURE.

In 1939 he was asked to take up the post of Director of Dairy Research to the Government of India, and, although not enjoying really good health, very gallantly answered the call of duty, as thousands of Englishmen had done before him. Although stricken by illness from the start, he laid the foundations of dairy research in India, and on St. David's Day, March 1, 1941, was started the Imperial Dairy Research Institute. Nothing could have been more desirable than that Davies should have been spared to impart his unique knowledge of dairying problems to the workers that he was gathering round him, but Destiny decided otherwise.

His death will be mourned by his many friends in the Institute of Chemistry, the Biochemical Society, the Society of Chemical Industry, the Agricultural Education Association, the British Dairy Farmers' Association and the Royal Agricultural Society of England, all of which societies he was a member. He is survived by his widow, son and daughter. J. G. D.

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Mr. C. H. Heap

Mr. C. H. Heap, Dyestuffs Adviser and Secretary of the Dyestuffs Group of the Association of British Chemical Manufacturers, died on April 25, 1941. Mr. Heap was employed by Brotherton and Co., Ltd., until 1930, when he joined the Association's staff.

The Association, Imperial Chemical Industries, Ltd., and the Dyestuffs Export Group were represented at the funeral by Mr. E. A. Bearder, Mr. Heap's predecessor as Dyestuffs Adviser.

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Mr. J. T. Greenwood, D.L., J.P.

We regret to report the death of Mr. J. T. Greenwood, D.L., J.P., Chairman of West (Butchers), Ltd. Mr. Greenwood, who was fifty-two years of age, joined the board of that company in the capacity of chairman when it became a public company in 1934. He was also Chairman of A. W. Gamage, Ltd., and of Wood, Rozelaar and Wilkes, Ltd., a printing firm.

* * *

Lady Vestey

Lady Vestey, widow of Lord Vestey, passed away at Gerrards Cross recently. Lady Vestey, who took an active interest in her husband's business affairs, at one time acted as Secretary of the Union Cold Storage Co., Ltd.

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National Agreement for Bakers

The Airdrie and Kilbirnie branches of the Scottish Union of Bakers, Confectioners and Bakery Workers are asking other branches to support the principle of a national agreement regulating wages and conditions. They suggest that the national agreement should become operative in 1942.

Agreements are at present made on a district basis.

The Royal Society

At a meeting of the Royal Society the following were elected to the Foreign Membership of the Society:

Dr. James Bryant Conant, President of Harvard University. Distinguished for his researches in organic chemistry and the application of physical methods to the elucidation of the mechanism of organic reactions; also distinguished for researches in bio-chemistry.

Dr. Karl Landsteiner, Member in Pathology at the Rockefeller Institute for Medical Research, New York. Distinguished for his work on immuno-chemistry, which has established the dependence of the specificity of the antigen-antibody reactions on known chemical structures.

* * *

Mr. Churchill, F.R.S.

Mr. Churchill has been elected a Fellow of the Royal Society, which is able to elect to fellowships persons who have rendered conspicuous service to science or whose election would be of benefit to the Society.

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The Rt. Hon. Thomas Wiles, P.C.

The Rt. Hon. Thomas Wiles, P.C., has been elected Chairman of the Port of London Authority, following the retirement of Lord Ritchie of Dundee. Mr. Wiles has served on the Board of the Port Authority since 1923, when he was elected as one of the members representing "Goods". He has been Vice-Chairman since 1934. He was Chairman of the Authority's Law and Parliamentary Committee from 1925 to 1934 and of the Finance Committee from 1936 to 1940. In 1899 Mr. Wiles represented South-West Bethnal Green on the London County Council, and was M.P. (Liberal) for South Islington, 1906-1918. He was Parliamentary Secretary to the Right Hon. T. McKinnon Wood (Financial Secretary to the Treasury and afterwards Secretary for Scotland). In 1916 he was sworn a member of His Majesty's Privy Council. He is a J.P. for Oxfordshire and Chairman of the Royal Surgical Aid Society.

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Fluorescent Tubular Lamps

It is claimed for the new 80-watt Fluorescent Tubular Lamp that for all practical purposes its light output is equivalent in quality to daylight. In certain circumstances it may even be superior to natural light, as is shown in an interesting installation recently designed by Crompton Parkinson, Ltd.

A vital chemical process in a Government factory involves the addition of acids to a liquid solution by carefully controlled stages, as a result of which the liquid changes in colour. These changes determine the point at which further acid is added.

The operation is so critical that it could normally only be carried out under the most favourable daylight conditions. The introduction of the Fluorescent Tubular Lamp promised an opportunity of providing controlled light closely resembling daylight but more constant in character. Investigation showed that an illumination of 120- to 150-ft. candles over a working area of 6 ft. by 4 ft. 6 in. would be necessary to provide sufficient illumination to enable the delicate changes in hue to be easily discerned.

A special fitting was therefore designed to accommodate four 80-watt Crompta tubes and was mounted at a height which ensured that the light source was not in the line of vision. As aluminium was not obtainable, the reflector was constructed of sheet brass with a chromium-plated reflecting surface, the exterior being painted with acid-resistant material.

This important process may now be continued day and night without interruption and with far greater efficiency—just one more illustration of the vital part which electricity is playing in the national war effort.

* * *

Royal Sanitary Institute

At an examination for inspectors of meat and other foods, held in London on May 16 and 17, thirteen candidates presented themselves. The following nine passed:

Norman Frank Collier (High Wycombe), Ronald Marchant Davies (Barry), John Benjamin Facer (London, S.E. 18), Gwilym Cyril Hopkins (Talgarth), Joe Howard (Croydon), William James Rees (Tregaron), Philip Thomas Shelton (Loughton), Harry Templeman (Eston), Norman Edwin Whitby (Mytchett).

At an examination in food hygiene qualifying for Associate one candidate presented himself and passed the examination. He will receive the certificate on attaining the age of twenty-one years—John Sargeant (Chelmsford).

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Smith's Potato Crisps (1929) Limited

The annual general meeting of Smith's Potato Crisps (1929), Ltd., was held on June 4 at the Holborn Restaurant, London, W.C.

Sir Herbert Morgan, K.B.E. (the chairman) said: "You will no doubt have seen that we propose to pay the same dividend as last year, together with the same cash bonus, and this, from the shareholders' point of view, is probably the most interesting statement that I can make.

A comparison of the trading between this year and last shows that the results are practically identical, the only outstanding difference being an increase of about £28,000 in our provision for taxation. This is a burden that we must all bear cheerfully and take satisfaction from the fact that we make such a substantial contribution towards the country's resources.

You will notice that our 'Cash at Bankers' and 'In Hand' has reached, as far as we are concerned, the record figure of £145,371. This is apart from our liquid investments which total £111,610. These two items together show an increase of £19,351 over last year.

Since the publication of the accounts, the directors felt that we should play our part in subscribing further to the National War Loan. We did this by investing a sum of £126,000 through the Chiswick and Brentford branch in London's War Weapons Week.

The maintenance of our profits and the strength of our financial position are proof positive of the soundness of the enterprise. It is a privilege to be able to say at this twelfth annual general meeting of the company that since the days of its creation we have made increasing progress and steadily gathered strength."

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R. S. M'Coll, Ltd.

The net profit of R. S. M'Coll, Ltd., manufacturing confectioners, Glasgow, for the year ended April 25, 1941, amounted to £21,759, against £29,969 for the previous year, and £5,878 was brought in. A dividend of 6¼ per cent., compared with 5 per cent., less tax, is recommended, and £5,000 again goes to reserve fund, leaving £11,800 to be carried forward.

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Vi-Products (Sheffield)

Vi-Products (Sheffield) was registered as a private company on May 12 with a capital of £5,000 in 5,000 shares to carry on the business of vitaminised foods, drinks and foodstuffs. The directors are: Ella H. Gasking, chairman and joint managing director of Batchelor's Peas, and Thos. S. Carter. Secretary: T. C. Nixon. Registered office: Clay Wheels Lane, Wadsley Bridge, Sheffield.

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Purity of Water Supplies

The Metropolitan Water Board is about to form a consultative committee of scientists who will advise the Board during the war, and for six months after on the purity of London's water supply.

Doctors, the London Schools of Hygiene, the Society of Medical Officers of Health and the Royal Sanitary Institute will be represented.

* * *

Co-Operative Vegetable Market

A co-operative society known as the Sandwich and District Growers, Ltd., with offices at Sandwich (East Kent), has been formed for co-operative marketing, primarily to look after growers' interests in connection with the sale of vegetable produce for canning and pickling.

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Waste Food Board

Members of the Waste Food Board are Mr. R. C. Morrison, M.P. (Chairman); Major A. C. Bonsor, M.P.; Miss M. Lloyd George, M.P.; and Lieut.-Colonel G. P. Pollitt.

* * *

Changes of Address

Owing to enemy action, Messrs. Lavino (London), Ltd., have moved from 29, Mincing Lane, E.C. 3, to 103, Kingsway, W.C. 2, to which address all enquiries should be sent.

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H. C. Stern advises that his new address is Bush House, Aldwych, London, W.C. 2. Telephone No.: Temple Bar 0311. Telegrams: Glastos, Bush, London.

INFORMATION AND ADVICE

Incorporating Wet Gluten with Wholemeal Flour—Sponge Mixtures—Information Supplied—Information Required

Incorporating Wet Gluten with Wholemeal Flour

7,429. *We shall be glad if you will kindly let us know what the percentage is to incorporate a percentage of wet gluten with wholemeal flour in the making of bread. It is not on a large-scale basis, but for home baking. We should also be glad if you could say the percentage that should be used.* (London.)

The quantity of wet gluten which can be used in wholemeal bread is at the rate of 1 lb. of wet gluten to 7 lb. of wholemeal. The wet gluten must be torn into small pieces and then mixed in with the other ingredients.

It involves hard work where this is done by hand, since it is no easy mater to obtain the gluten uniformly distributed throughout the mass of the dough. Unless the gluten is properly distributed, harsh wet patches may occur in the finished loaf.

Less than this amount can be used, but if the aim of making the addition is to produce a starch-reduced loaf for a special type of consumer suffering from glycosuria, this amount should prove satisfactory in making a most attractive loaf. The dough containing the gluten should be well fermented so as to produce a light good wholemeal loaf.

Sponge Mixtures

7,169. *Would you please be kind enough to let us have a recipe for making sponge mixtures?* (Surrey.)

There are many varieties of sponge mixtures to choose from, and the mixture you use will depend on what you wish to make from the mixture. For instance, there are various recipes for sponge cakes, another variety for sponge sandwiches, and still others for sponge rolls, just to mention a few of the varieties of goods that are made from sponge mixtures. If you would study the book on *Cake-making and Small Goods Production* by Bennion and Stewart, you would then find out what types of goods can be made and how to make up a recipe that will suit the type of goods that are required to be made.

Here are two recipes that are suitable for either small sponge cakes or for sponge sandwiches, which under present circumstances will, of course, have to be modified as to some ingredients.

The following recipe and method should be used to produce good penny sponge cakes or sandwiches :

2 pints eggs. 2 lb. castor sugar.
2 lb. soft flour.

To obtain the best results the eggs and sugar should be heated together in the machine bowl over a pan of hot water to a temperature of 85° F. They should then be whisked together until sufficiently light and aerated. This usually requires about ten minutes, but when the mixture is ready it will be noticed that the impressions made by the revolving wires remain for some seconds before closing together again. The whisk should be removed and the well-sifted soft flour should be shaken in gradually yet quickly while mixing it into the batter. Care must be taken not to break the air cells by rough handling or over-mixing while stirring in the flour, otherwise the finished cakes will be tough and heavy. The mixing should either be done by hand or with a spoon, folding the flour as gently as possible.

The batter should then be filled into a savoy bag with a large tube in it and piped out into the prepared frames. Dredge over the batter in the frames lightly with castor sugar and throw off the surplus sugar, then bake on the sole of the oven at a temperature of 380 to 400° F. with the door partly open. When baked, turn out immediately on wire trays to cool before packing ready for sale.

Care should be taken to have the frames ready prepared by cleaning, greasing with fat, dusting out with sugar, then with flour, before the batter is ready. Also, as soon as possible, get the goods into the oven after filling the frames. No time should be wasted after the batter is ready until the goods are in the oven.

If sponge sandwiches are made from this mixture, scale it out into sandwich pans which have been lightly greased and dusted with flour. Bake them at 400° F.

If you use the following recipe you will get fairly good sponge cakes or sandwiches :

2 pints eggs.	2 oz. baking powder.
2 lb. 10 oz. sugar.	2 oz. glycerine.
3 lb. 6 oz. flour.	½ pint milk.
½ pint cooking oil.	egg colour.

The eggs and sugar are whisked together to a sponge. The flour and baking powder are thoroughly sifted together. The glycerine and egg colour are mixed into the milk. When the sponge is ready the flour is added to it with the milk, then the oil is added, and the whole is mixed to a clear batter. There is sufficient batter in this mixing to make fifteen sponge sandwiches deposited at 10 oz. each. These should be baked in a moderately hot oven about 400° F. After baking them allow to cool and mature for a day, then sandwich with raspberry jam or a cheap creamy filling.

Information Supplied

6,655. *I have an enquiry for a small Kidney Bean Slicer, hand or power model, to deal with about 50 lb. beans per day. Do you know of a maker or stockist of such machine?* (Leicester.)

Names were given.

6,660. *Can you recommend any Slicing Machines similar to Birkel for cutting ham, bacon, etc., electric driven, suitable for A.C. or D.C. motors, 230 volts, 3 phase, 50 cycles?* (Manchester.)

Names of manufacturers were given.

6,668. *In the near future I should like to have a consultation on Jams and Syrups with a competent authority, and would be glad to have your recommendation.* (Woodbridge.)

We suggest that you get in touch with the British Association of Research for the Cocoa, Chocolate, Sugar, Confectionery and Jam Trades Laboratory, 2, Dalmeny Avenue, London, N. 7.

6,808. *Will you give the names and addresses of manufacturers of Pea and Bean Filling Machines, also Vacuum Capping Machines?* (Belfast.)

This was done.

6,906. *We wish to get in touch with second-hand dealers of Bakers' Machines.* (Eire.)

Names of second-hand dealers were given.

7,119. *We will be pleased to have advice on the ingredients required and the method of manufacture of "Post Toasties", and also a manufacturer's quotation for the necessary plant.* (South Africa.)

This is a highly technical business, and we suggested that the enquirer should consult an expert, and also gave names of makers of machinery.

7,124. *I shall esteem it a favour if you will kindly let me know the name and address of makers of modern plant for the manufacture of hydrogenated products from cotton seed and ground-nut oils.*

These were given.

7,138. *We should be glad if you would give us the name and address of a reputable firm of gear cutters with a worm drive.* (Newport.)

Names were given.

Information Required

7,442. *Can you give me any information as to how puffed wheat is made; also the names of firms capable of supplying the necessary machinery to produce this article?*

7,480. *We contemplate manufacturing macaroni, noodles, vermicelli, etc. Are you able to furnish us with literature, recipes and methods, or to put us in touch with experts, machine manufacturers, etc.?* (London.)

RECENT PATENTS

These particulars of new patents of interest to readers have been selected from the "Official Journal of Patents", and are published by permission of the Controller of H.M. Stationery Office. The journal can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, price 1s. weekly (annual subscription £2 10s.).

Abstracts of Recent Specifications

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, either sheet by sheet as issued on payment of a subscription of 5s. per Group Volume, or in bound volumes price 2s. each.

Process for the Manufacture of Whey Powder

It is an object of the invention to provide a process which will permit the production of a satisfactory, stable, non-caking dry whey powder from any type of raw whey now available on the market.

It is a further object of the invention to provide a process of the above character which will facilitate and permit rapid formation and growth of alpha lactose monohydrate, whereby the final stabilised powder can be obtained without a long period of set.

According to the invention, a process for producing a dry non-caking whey powder, in which moisture is removed from raw whey and the lactose content caused to crystallise, comprises coagulating a major part of the whey protein by the application of heat in the presence of a mineral acid in an amount to maintain the *p*H value below 4·8 and thereafter crystallising the lactose in the presence of such coagulated proteins.

Whey proteins consist principally of lactalbumin, together with a small amount of lactoglobulin. In whole milk such proteins act as protective colloids, in holding casein in colloidal suspension. The presence of uncoagulated whey proteins greatly influences the process of crystallising lactose, and, together with lactic acid and mineral salts, apparently exercises an effect on the equilibrium between alpha and beta lactose in the whey. In any event, it has been determined that the presence of substantial amounts of uncoagulated whey proteins during or after formation of lactose monohydrate is a distinct detriment to production of a satisfactory product. This can be better understood by pointing out that uncoagulated whey proteins, particularly lactalbumin, when mixed with lactose, lactic acid and water, form a very sticky mass which is difficult to dry and handle. Even in processes utilising raw material which is fairly easy to process, and in which there may be fairly complete coagulation of whey proteins during the setting or drying steps, the presence of the whey protein in uncoagulated form during at least the initial part of the setting period serves to retard the rate of setting and the rate of crystal growth.

To coagulate the major part of the whey proteins, prior to crystallisation of lactose, heat treatment of the liquid whey is applied, while the whey contains a mineral acid, such as sulphuric acid, or hydrochloric acid, in an amount to maintain the *p*H value below 4·8. The temperature required to effect coagulation depends somewhat upon the period of heat treatment and upon the hydrogen ion concentration. With raw whey difficult to handle by prior process, and containing a relatively high percentage of lactic acid, mineral acid is added to adjust the hydrogen ion concentration to below *p*H 4·8 (Sorenson's unit), while the temperature of heat treatment can be in the neighbourhood of 100° F. for a period of about ten minutes. With such values it is possible to effect coagulation of the major part of the whey protein without such undue prolongation of heat treatment as to cause caramelisation. It is important to avoid caramelisation because a final caramelised product is undesirable, due to its characteristic colour and flavour.

This treatment is preferably carried out simultaneously with concentration of the raw whey, preparatory to the final stages of the stabilising process. It is possible, however, to apply the coagulating step prior to concentration, after which the whey is concentrated and further treated to produce a stabilised dry material. Preliminary coagulation of proteins prior to concentration enables the use of lower temperatures in the concentrating step, which in some instances may be desirable where the concentrating methods utilised required an extended period of heat treatment.

It is also possible to effect coagulation after the concentration operation, but before the formation of lactose crystals. Such practice also enables the use of lower temperatures in the concentrating operation, with a short period of heat treatment after concentration to effect substantial coagulation, as previously explained. We have discovered that an operator should take into account the fact that the *p*H value of the liquid whey tends to lower, with an increase in concentration. Therefore where mineral acid is being added in the coagulating operation—for example, to a whey containing a relatively high percentage of lactic acid—less mineral acid will be required in treatment of concentrated whey, as compared to treatment of the same whey before concentration.

After the coagulating operation and before crystal formation the whey can, if desired, be partly or completely neutralised by the use of a suitable chemical such as lime.

534,214. David Dart Peebles and Paul de Vries Manning.

Latest Patent Applications

111. ASCH, H.: Process for the concentration, etc., of sterols from fats.

204. PALESTINE OIL INDUSTRY "SHEMEN," LTD., and BETTER, E.: Substances suitable for use as baking-flour.

259. GURWITSCH, L.: Manufacture of solidified edible fats.

601. PORTER, F.: Cooking apparatus.

873. BAKER PERKINS, LTD.: Method and apparatus for discharging loaves of bread, etc., from pans.

879. NOONE, E.: Machines for making tea, etc.

880. NOONE, E.: Apparatus for dispensing boiling-water.

Specifications Published

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, at the uniform price of 1s. each.

532,608. KUSTNER FRERES AND CIE SOC., ANON.: Machines for cutting and wrapping frozen masses.

532,832. WEBSTER, R. W.: Machines for cleaning cans, jars and other containers.

532,853. WYK, S. G. VAN, HEYMAN, E., JUSTESEN, A. C., and JORGENSEN, P. E.: Preparing tea product and products obtained thereby.

532,873. DANIELS, T.: Moulding sweetmeats.

TRADE MARKS

The list of trade marks of interest to readers has been selected from the "Official Trade Marks Journal" and is published by permission of the Controller of H.M. Stationery Office. The journal can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, price 1s. weekly (annual subscription £2 10s.).

NEWMALADE.—613,601. Fruit preserves. **William Moorhouse and Sons, Ltd.**, Sunglow Model Factory, Old Lane, Beeston, Leeds 11; Jam Manufacturers.

ALIMIL.—613,642. Dried milk in powder form. **Fitzroy Laboratories, Ltd.**, Mount Pleasant, Alperton, Wembley, Middlesex; Manufacturers.

SECOV.—613,644. Egg substitute. **A. Goldrie and Co., Ltd.**, Tabard House, 116, Southwark Street, London, S.E. 1; Merchants.

VITACRISP.—613,821. Potato crisps. Isaac John Moore, trading as **Bindon-Moore Caterers,** 316-318, King's Road, Chelsea, London, S.W. 3; Caterer.

POMPLIM.—613,859. Preparations consisting principally of carbohydrates for use in making bread. **Axel Thorrald Friis-Andersen**, Napelton House, Zeal Monachorum, Bow, Devon; Manufacturer.

BICKIEPEG BROTH.—613,948. Soups, soup pastes, soup powder, soup tablets and soup flavourings. **Bickiepegs, Ltd.**, 46, Tewin Road, Welwyn Garden City, Hertfordshire; Manufacturers. To be Associated with No. 447,924 (2410) xlii.

GYP.—611,159. Flavourings (other than essential oils), sauces, spices, condiments. **Fletchers Sauce Co., Ltd.**, The Sauce Works, Barlby Road, Selby, Yorkshire; Manufacturers. To be Associated with No. 611,158 (3253) ii and another.

NEW COMPANIES

Frayling, Limited. (365005.) 2A, City Road, Cardiff. To carry on bus. of mnfrs. of and dlrs. in confectionery, sweets, etc. Nom. cap.: £500 in £1 shares. Dir.: Lillian F. Frayling, 10, Dan-y-Coed Road, Cardiff.

Fruit Pulp Association, Limited. (365771.) Nom. cap.: £5,000 in £1 shares. Dirs.: F. A. Maskell, 234, Watford Road, Harrow; R. A. Easton, 52, Sweetcroft Lane, Hillingdon, Middlesex, and 4 others.

H. H. Goodacre and Sons, Limited. (365734.) Castlefords Market, Sheffield. To carry on the bus. of wholesale fruit, potato and vegetable mchts., etc. Nom. cap.: £2,000 in £1 shares. Dirs.: H. H. Goodacre, 4, Avondale Road, Sheffield (permt.); H. Henry Goodacre, 15, Milden Road Sheffield; G. W. Goodacre, 47, Milden Road, Sheffield.

H. and S. Traders, Limited. (365735.) To carry on the bus. of fruiterers, greengrocers, bacon factors, etc. Nom. cap.: £600 in £1 shares. Permt. dirs.: H. A. Hancock, address not stated. J. R. Hunt, Driftwood, Whinneys Road, Loudwater, High Wycombe; C. G. Clack, 136, Langley Road, Slough, Bucks.

J. J. Home-Made Style Confectionery Company, Limited. (365713.) 15A, Jamaica Street, Stepney, E. 1. To take over the bus. cd. on by J. Jacobovitch. Nom. cap.: £500 in £1 shares. Dirs.: J. Rosenberg, 7, Edgeworth Avenue, N.W. 4 (permt. dir. and ch.). J. Jacobovitch, 14, Dempsey Street, E. 1.

F. E. Jackson, Limited. (365729.) 27, Bridlesmith Gate, Nottingham. To carry on the bus. of butchers, provision mchts., etc. Nom. cap.: £1,000 in £1 shares. Dirs.: F. E. Jackson and Mrs. A. M. Jackson, both of 115, High Road, Beeston, Notts.; Mrs. H. M. Carter, 11, Broadgate, Beeston, Notts.

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